SOIL SURVEY OF GARRARD COUNTY, KENTUCKY.

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DESCRIPTION OF THE AREA.

Garrard County is situated in the east-central part of Kentucky. The Kentucky River forms the northern boundary. Paint Lick Creek and Dix River, flowing from the south to the Kentucky River, form the eastern and western boundaries. The county is irregular in outline, with a width of about 12 miles and a length of about 32 miles. It comprises an area of 237 square miles, or 151,680 acres.

FIG. 20.—Sketch map showing location of the Garrard County area, Kentucky.

The county lies at the southern border of the bluegrass region of Kentucky. Most of it lies within the bluegrass region, but on the south it extends some distance into hill country known as the Knobs.

The bluegrass region in general is a broad, undulating plain, bordered on the east, south, and west by high, rugged hills, and extending to the Ohio River. Within this plain the rivers have cut deep, narrow valleys. In parts of the region where the rock is soft, the smaller streams also have cut deep valleys. But much of the plain overlies rather dense, hard limestone, into which only the rivers, with their more continuous flow of abrasive sediment-laden water, can cut very fast. The local streams flow through shallow, narrow valleys in an undulating or gently rolling country.

The bluegrass region has been described as consisting of an inner bluegrass section of smooth surface features, centering about Lexington, surrounded by a belt of more deeply dissected, hilly country occupying the outcropping area of the Eden shales, and this, in turn, surrounded by an outer bluegrass section of smooth surface features. These three divisions are nearly equal in extent, the inner bluegrass section comprising 2,400 square miles, the area underlain by the Eden shales 2,500 square miles, and the outer bluegrass section 3,200 square miles.[1]

The Eden shale and outer bluegrass belts are variable in width. On the southern side they are comparatively narrow. Each of the three divisions is represented in Garrard County, but the surface features of each have been altered by weathering to a greater degree than is characteristic elsewhere in their wider expanses. The inner bluegrass division includes some strongly rolling country, the Eden shale division is very deeply dissected, and the outer bluegrass divi-

[1] The Geology of Kentucky, by A. M. Miller. Series 5, Bul. 2, Dept. of Geology and Forestry of Kentucky, page 180 et seq.

sion has been reduced to a generally rolling or hilly topography. Most of the bluegrass land of Garrard County is of rolling or hilly topography, and some of it is very hilly. Looking across country one sees smooth ridges or hills rising one after the other to the same general level, but the intervening valleys and hollows are deep.

The dissection is in large measure due to the situation on the rivers. The Kentucky River flows through an especially deep valley. In the more massive limestone formations of the northwestern part of the county both the Kentucky and Dix Rivers flow through deep gorges with sheer cliff walls, in some places over 300 feet in height. Dix River and Paint Lick Creek have a rather rapid fall, but as the general slope of the upland is to the north their upper valleys in the county are likewise well below the general upland level.

The inner bluegrass section is represented in a stretch of country along the lower course of Dix River. This includes the most extensive smooth areas in the county. In the vicinity and to the west of Marksbury, Camp Dick Robinson, and Bryantsville the country is generally undulating or gently rolling up to the brink of the gorge. The streams of this section flow through shallow valleys, emptying into the gorge in a succession of rapids and falls. Farther north in this district the water courses generally occupy deeper valleys and the greater part of the country is quite rolling, but includes extensive areas having favorable topography.

The Eden shales country, occupying the north-central and northeastern parts of the county, and a small section of country west of Lancaster, is deeply and thoroughly dissected. In this country the branches flow into Kentucky River and Paint Lick Creek without falls and have cut deeply to their headwaters. Sandstone caps the ridges near the river and generally upholds the plain level to the brink of the narrow river valley. The rock does not form cliffs, but the river hills are steep. Farther back the country is a succession of narrow, even ridges and deep hollows.

The outer bluegrass country, occupying the south-central part of the county, is for the most part rolling to hilly. Even on the main divides the former even surface is generally reduced to a rolling surface. At stream junctures the points slope down gradually. The valley slopes for the most part are not steep or very uneven, but along the larger streams they are in places much steeper than is desirable for cultivated land.

Near the outer margin of the basin there is some even "flatwoods" country, which is supported by massive limestone. In most places it is little more than a half mile in width and does not extend far out along the main divide. It is not continuous, but occurs in several bodies in the vicinity of Hammack and Cartersville. The surface is undulating to flat, and includes some poorly drained areas.

The hills bordering the bluegrass lowland are known in Kentucky as the Knobs. They correspond to the similarly rugged Highland Rim about the central basin of Tennessee. The Knobs in Garrard County rise abruptly from the lowland, the first range reaching the same height as those farther back and standing about 300 feet above the lowland. The streams of the Knobs have cut their valleys down

nearly to the level of the lowland, so that the whole district is very rugged, except for occasional graded lower slopes. The higher slopes are very steep, with occasional long ledges, outcrops, and cliffs at the shoulders of the hills. The ridges are narrow and cut away in many saddles, leaving short ridges or isolated knobs.

Throughout the limestone country there has been little development of smoothly graded lower slopes. In many places the lower slopes are somewhat steeper than the upper ones. None of the streams have approached base level. They generally have only narrow bottoms and flow on bedrock. In the Knobs the cutting of the larger streams has been retarded by the more resistant beds at the base of the formation, so that the bottoms are wider; but in many places the streams flow over bedrock. All the upland is well drained, except for some inextensive flatwoods areas.

There are thus three main levels in the county—that of the river, that of the bluegrass levels, hills, and ridges, and that of the Knobs. Lock No. 7, 1¼ miles above Highbridge, is 500 feet above sea level. Buckeye is about 950 feet; Bryantsville and Lancaster are about 1,000 feet; Hammack is about 1,100 feet; and the Knobs are indicated as reaching elevations of about 1,400 feet in the county.

The population of the county was 12,503 in 1920. Lancaster is the only town of any size, and the interests of the county are nearly altogether agricultural. The residents are mostly the descendants of early settlers from the English colonies to the east. In recent years others have come from the mountain counties of eastern Kentucky. The negro population is about 15 per cent of the total.

Lancaster is the county seat and principal market, with loose-leaf tobacco houses, grain elevator, and roller mill. A branch road of the Louisville & Nashville Railroad passes through the county, connecting with other lines of the Louisville & Nashville at Richmond and Stanford, which give access to the markets of Louisville and Cincinnati. There is no local traffic on the river. Lexington is about 35 miles from Lancaster by pike, and some tobacco is marketed there. The main roads of the county are all piked. There is good telephone service through most of the county.

CLIMATE.

The climate of the county is temperate. The winter is of moderate duration, and while the weather is more or less changeable, the periods of colder weather are usually short. Snow seldom lies for any great length of time. The summers are long and warm, with some hotter spells of short duration.

The mean annual precipitation at Berea, in Madison County, is 48.17 inches; at Lexington it is 45.38 inches.

The average date of the latest killing frost in spring is April 17, and of the earliest in fall October 15. The latest frost recorded in spring occurred on May 9, and the earliest in fall on September 14.

The table below is compiled from the records of the Weather Bureau station at Berea, Madison County. The data are considered representative of conditions in Garrard County.

Normal, monthly, seasonal, and annual temperature and precipitation at Berea, Madison County.

(Elevation, 1,070 feet.)

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1904).	Total amount for the wettest year (1915).	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	36.7	71	−21	4.59	3.20	6.99	5.3
January	37.3	76	−14	4.53	3.14	4.84	5.4
February	35.8	76	−12	3.17	1.63	2.14	4.7
Winter	36.6	76	−21	12.29	7.97	13.97	15.4
March	47.3	88	4	4.93	5.89	2.60	3.8
April	55.6	89	20	3.61	2.01	1.14	.5
May	65.8	96	30	3.98	5.10	6.46	T.
Spring	56.2	96	4	12.52	13.00	10.20	4.3
June	72.5	101	37	4.88	1.81	5.01	.0
July	76.4	104	46	4.91	2.29	9.52	.0
August	74.6	102	44	4.94	5.01	7.38	.0
Summer	74.5	104	37	14.73	9.11	21.91	.0
September	69.3	98	31	2.66	.99	1.53	.0
October	58.5	91	20	3.07	.93	7.80	T.
November	47.2	79	6	2.90	.57	5.02	.8
Fall	58.3	98	6	8.63	2.40	14.35	.8
Year	56.4	104	−21	48.17	32.48	60.43	20.5

AGRICULTURE.

The fertile soil of the bluegrass region attracted settlers from the Atlantic slopes even in colonial days. Lancaster was founded by settlers from Lancaster County, Pa. For a time agriculture was little more than self-sustaining, but later stock and grain became important exports. Hemp was introduced about 1775, and has always been grown to some extent. Until more recent years, general farming and stock raising was the common practice. For a time hemp was grown rather extensively, and now tobacco has become a very important crop. The general changes of the last 40 years are shown in the reports of the Federal census. They reflect conditions in the bluegrass region rather accurately, as the county has no manfacturing industries, and even in 1890 lumbering was not of great importance. The acreage of improved land in the Knobs is not very large.

In 1880 the county was nearly as thickly settled and as extensively farmed as at present. The population then numbered 11,704; it is now 12,503. The area of improved land has been increased from about 112,000 to 118,000 acres. The farms have been gradually subdivided, and the number thus increased from 1,099 to 1,929. The total valuation of farm properties increased from $3,653,076 in 1880 to $9,360,056 in 1910 and to $20,144,258 in 1920. These largely increased values were in a period of high prices, especially of grain and tobacco.

The following table, complied from census records, gives a general indication of the agricultural development in the last 40 years.

Acreage of leading crops, 1879, 1889, 1899, 1909, and 1919.

Crop.	1879	1889	1899	1909	1919
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Corn	24,446	19,868	20,477	24,443	27,340
Small grains	18,066	17,712	19,843	11,664	12,098
Hay	2,055	4,596	7,459	6,248	4,026
Hemp	(1)	1,418	1,412	703	(2)
Tobacco	89	684	869	3,461	11,998

[1] 143 tons. [2] Not reported; acreage very small.

It will be seen from this table that the acreage in corn has not increased to any marked extent. The production of small grains has decreased considerably. The production of hay has doubled. Tobacco has become a very important crop in place of hemp. The total acreage in these various crops increased from about 45,000 to 56,000 acres. About half of the improved land as classified by the census, is in pasture, orchards, farmsteads, and a few minor crops of small acreage.

The following table shows the values of crops and livestock products in 1909 and 1919, as reported by the census:

Values of crops and livestock products, 1909 and 1919.

	1909	1919
Crops by classes:	*Dollars.*	*Dollars.*
Cereals	608,886	2,056,228
Other grains and seeds (hemp seed, bluegrass, etc.)	6,558	3,250
Hay and forage	64,176	235,734
Vegetables	51,040	96,742
Fruits and nuts	25,246	5,287
All other crops (mainly tobacco)	524,990	2,556,097
Livestock and livestock products:		
Animals sold and slaughtered	590,923	(1)
Dairy products, excluding home use	52,942	127,994
Poultry and eggs	147,760	278,260
Wool	4,813	8,904

[1] Not reported in the census.

These valuations indicate a relatively large income per farm. Some allowance, however, must be made for duplication of feed values in the table. Average values may be estimated by comparison of the values of these two years.

The following table, compiled from the census, gives a more detailed statement of the acreage and production of the leading crops:

Acreage and production of leading crops in 1909 and 1919.

Crop.	1909		1919	
	Acres.	*Bushels.*	*Acres.*	*Bushels.*
Corn	24,443	948,368	27,340	993,230
Oats	832	11,345	1,416	21,808
Wheat	10,164	124,413	9,691	126,788
Rye	585	4,450	920	7,516
Barley	83	1,390	50	479
		Tons.		*Tons.*
Timothy	3,710	4,046	1,452	1,477
Clover			558	526
Timothy and clover mixed	1,448	1,468	1,913	1,957
		Pounds.		*Pounds.*
Tobacco	3,461	3,563,086	11,996	11,073,655
Hemp	703	638,190	(1)	(1)

[1] Not reported; very small.

Different types of farming prevailing in the county may be thus classified: (1) General farming on a small scale, with tobacco as the chief source of income; (2) general farming on rather small farms, with income from various sources, such as tobacco, wheat, dairy products, and stock; (3) general farming on tracts of 150 acres or more, where farm operations mainly center on the production of feed for stock, with tobacco and wheat as cash crops, much of the tobacco being produced by outside labor; (4) heavy farming, with production of corn and tobacco, as previously mentioned, (5) farming in the Knobs, with income from livestock and their products, and crops to supply home needs.

In general farming corn is the main grain crop. Wheat is generally used in seeding land to grass. It is grown to some extent without seeding down, but is generally regarded as of little profit as a straight cash crop. While oats are not very productive in comparison, they may be preferred for feeding purposes, or grown where wheat and rye have been frozen out. Rye is used as a cover crop, both for winter cover and pasture, and as a nurse crop for clover. The value of clover as a fertilizing crop is emphasized as much as its feeding value. Clover largely takes the place of bluegrass for this purpose, since a period of years is required for bluegrass to effect the same results. Tobacco is the main source of income on many farms.

Production of livestock for slaughtering is much more important than dairying. Cattle and hogs are fed on most of the farms. The smaller farmers keep only a few head of cattle and rather commonly sell the young stock as yearlings to feeders in the county. A good many yearling cattle are brought in from the adjoining counties. Cattle are fed out and marketed either in shape for slaughter in this county or as heavy "export" cattle. The production of export cattle has, however, declined.

The cattle are mainly grades of the beef breeds. There are a few herds of purebred cattle in the county, principally Aberdeen-Angus.

Dairying is mostly on a small scale and declines in winter. It is stated, however, that the industry is growing, especially on the smaller farms. Butter and cream are marketed either in local markets or in Cincinnati. There is a small creamery at Lancaster.

Hogs are of various improved breeds, the Durocs being rather popular. They are pastured to a considerable extent and run in harvested fields. Hog-tight fences are common in most parts of the county. The animals are fed out on corn at various seasons. Considerable numbers are marketed through the summer. Cincinnati is the principal market.

Small flocks of sheep are kept on many farms. It is said that about 5,000 lambs are marketed each season. The stock is mainly of "native" or "mountain" sheep. These are of Merino strains from the mountain counties. Selected animals are of good size and vigorous and are commonly preferred to western stock. These are crossed with Southdown, Hampshire, Shropshire, or other mutton breeds. Little effort is made to produce lambs for the earlier market. February lambs may be marketed at about 80 pounds weight in June and July. Sheep raising is regarded as a good practice in general farming. Wheat and rye are grazed. Grazing wheat after February 15 reduces injury

from the Hessian fly. Sheep also graze weeds and thus prevent seeding.

Corn is the important grain crop of the county. On clover or clover and timothy sod it is grown one or two years; on bluegrass sod it may be grown two to four years; on bottom lands it may be grown even longer; following tobacco or hemp, large yields are obtained.

Enough corn is cut to supply fodder through the winter, but the stalks are generally left in the field, especially on hillsides, and stock is run in the field. Much of it is plowed or disked down in the fall on hilly land. On some stock farms more or less corn is hogged down. Silage is not very largely produced; in 1919 silage was cut from only 182 acres. Nearly all the corn produced is fed in the county. Some 30,000 or 40,000 bushels, however, are marketed at Lancaster.

Wheat is the principal small grain grown in the county. It is grown mainly as a nurse crop for clover and grass. It was formerly regarded as an important cash crop. During the recent period of high prices it was not grown as extensively as in 1909. In one case wheat has been grown for four years in succession in a field of Shelbyville silt loam. Some farmers grow a crop of wheat between corn crops. This crop affords some cover through the winter.

Commonly the wheat is seeded in disked corn land. When grown on tobacco land, wheat produces 25 or 50 per cent higher yields than on corn stubble. The grain is generally threshed from the shock. The average yield in census years has been about 10 to 14 bushels per acre.

Oats are not very commonly grown. The crop does not afford winter cover, and the yield is not large, averaging about 8 to 10 bushels per acre in the census years. The climate is unfavorable. The crop is likely to be affected by dry weather while the grain is being matured, and a heavy growth is likely to lodge. Some of the crop is cut and baled for hay, and some is fed in the sheaf, but apparently the greater part is threshed.

Rye is used as a cover crop rather than a grain crop. It is frequently sown on tobacco land or corn land, grazed through the winter, and turned under in spring. It is used to some extent on steep hillsides as a nurse crop for clover and grass, and much of it is not cut. When harvested, it is used mostly as hog feed.

Red clover is a very important crop in the bluegrass country. The acreage of clover reported by the census is apparently the acreage cut for hay and does not include the clover grown primarily for soil improvement, pasture, or seed. The sales of red clover seed to the farmers of the county are estimated to have exceeded 500 bushels annually for a number of years. A crop of clover effects such good tilth and fertility that the growing of clover is locally termed "resting the land," especially when it is used for pasture rather than for hay. The grazing of clover is a fairly common practice, especially in the hillier sections. Clover thrives on all but the shallowest and heaviest soils of the bluegrass country. On heavily farmed land it is sometimes difficult to get a stand, but on land which is seeded to clover in short rotations no difficulty is experienced. The prevailing opinion among farmers is that clover should be grown at least every five years.

Red clover is seeded with small grain, or occasionally without a nurse crop, at the rate of a bushel to 6 or 8 acres, in some cases 10 acres. The young clover in stubble is pastured to some extent. The main growth of the second year is mostly harvested, except on the steeper hillsides, where much of it is pastured. On stock farms it is used for pasture in connection with bluegrass. Yields apparently run from 1 to 2 tons per acre.

Alsike clover is preferred by some for pasture, especially on hillsides, as it "hugs the ground" more and is somewhat more persistent. It forms a lower and more spreading growth and is very effective in preventing wash.

One field of alfalfa was observed in the county, on a second bottom. It is said that alfalfa has been tried on the uplands without success. At present there is no great incentive to the production of alfalfa, because a short rotation with clover is desirable. However, alfalfa should succeed here, for it has been grown successfully elsewhere on soils that are similar to the Shelbyville and Lowell silt loams.

Sweet clover is grown extensively on shallow and rocky limestone soils and on eroded land. It is used mostly to build up fertility and prevent erosion, but is valuable for pasture. In one field of Shelbyville silt loam sweet clover had been sown. It was stated that the land had been heavily farmed, and the crop was intended to build it up. During early summer it grew in thick stand about 6 to 8 feet high.

Some timothy is commonly seeded with clover. On the larger farms meadows are cut a season or two after the clover has run out. Timothy produces well on the soils of the limestone and sandstone country, yielding a ton or more of hay per acre. Whitetop is a rather troublesome weed. These grass lands may be used for pasture for a number of years. The red clover reseeds and endures in these pastures to a considerable extent, and bluegrass gradually displaces the timothy in about five years. Timothy sod does not give as good yields of corn as does clover sod and is not considered satisfactory for planting tobacco.

Redtop is more commonly used on the soils of the Knobs. It is not as productive as timothy, but is more persistent and forms good mowings and pastures on these soils for several years.

At present there is not a great extent of bluegrass pasture left on the better farm lands of the county. Much of the old sod was broken for crop production, even on rather stony and steep slopes, during the war period. It is generally considered unprofitable to leave good farm land in bluegrass. Good bluegrass pasture has rented at rates ranging from about $3 per acre per season 10 years ago to about $12 at present. It requires about five years from the time of seeding with clover to form a good bluegrass sod, and this is regarded as too long a time to keep the land out of rotation. To get a sod in shorter time requires heavy seeding, which is considered too expensive for general practice. When a bluegrass sod has formed it is soon broken, for it forms especially productive tobacco and corn land. One old bluegrass field on a rather steep slope is said to have been farmed to tobacco, corn, and some hemp for the last nine years and to maintain yields well.

Some bluegrass seed is harvested. The grass is left unpastured until about June 1, when the seed matures. It is stripped with a hand stripper or with a 1-horse stripper. Although there is more or less waste, 10 bushels or more per acre are obtained, and in good years 20 bushels. One producer states that the later pasture is so much improved that harvesting the seed is profitable on this account alone in dry seasons. Some farmers graze the bluegrass close for a time in spring, before removing the stock, and harvest the seed later.

Tobacco is now the principal source of income through nearly all the bluegrass country in the county, and is grown on all the soils and on nearly every farm, except in the Knobs. The crop was formerly grown only on newly cleared land or on bluegrass sod, but for years it has been grown on red-clover sod in rotation with other field crops. Bluegrass sod gives somewhat better quality and higher yield, but on clover sod the yield is maintained at about 1,000 pounds per acre, without the use of commercial fertilizer. It is recognized, however, that land must be in a high state of cultivation for successful tobacco production. The term "tobacco land" is applied to land, even somewhat stony land, that has been in bluegrass until recently.

Burley tobacco must make a rapid growth to produce a good quality of tobacco. The plants are set close not only for full yield but in order to shade each other. The acreage of tobacco land is comparatively large in the county, for land not in a sufficiently high state of cultivation may soon be built up and maintained as tobacco land by the use of red clover in a 3 or 4 year rotation. However, "tobacco land" is valued much higher than other land of the same soil type, rather stony hill land in bluegrass being valued as highly as rather smooth land which has been rather heavily farmed. Exhaustion of the mineral elements of fertility by tobacco has not been experienced on the main tobacco soils. In one instance tobacco is said to have been grown on Culleoka gravelly silt loam for six years in succession, with some application of manure. The later yields were diminished, but after "resting" in clover, good yields were again obtained. However, probably comparatively few fields have produced more than 10 or 12 crops altogether.

On bluegrass sod, and to some extent on clover sod, two crops of tobacco are grown in succession. The second crop is not usually as heavy as the first, but is said to be commonly of somewhat better quality. The fertilizing value of the fallen trash, roots, and suckers doubtless is an important factor in maintaining productiveness, as these are especially rich in potassium. The tobacco stalks are always scattered out as manure for wheat or tobacco.

On the whole, tobacco is less subject to drought injury than is corn. On shallow soils, dry weather retards the growth, but the deep taproot keeps the plant supplied with sufficient moisture to prevent withering. After the drought is broken the plant makes a "second" growth and may yield well, though the quality is not so good as where growth has been more continuous.

Various strains of White Burley are grown. Much of the seed is obtained from local producers, and some of these strains or varieties are popular in other counties of the bluegrass region. Practically all of them are "upstanding," with a longer, narrower, more upright

leaf than that formerly preferred. These give slightly lower yields but finer quality. It is difficult to keep these strains pure, the plants in any field showing various habits of growth.

Plants for setting are commonly grown by each farmer. They are generally transplanted in the field by hand, though on level land tobacco planters lighten the work and give more satisfactory results. A smooth, fine seed bed is necessary, but this is not difficult to obtain on sod land. The plants are commonly set at 14 to 18 inch intervals in rows 3½ feet apart. The early growth is slow, but when once established and well rooted the plants make quick growth and finally meet across the space between rows.

With the upstanding Burley and present methods, the labor of production is not as great as formerly. The plants are allowed to bloom, when they are topped at 14 to 18 leaves. By this method the plants do not sucker so much. Suckers are usually broken out twice. The crop is also usually dusted lightly with some arsenate of lead.

The labor of growing the crop is usually distributed by making two or more plantings. Most of it is planted sometime in May, though it may be planted as late as the latter part of June. The earlier crop is harvested in late August; most of it is harvested in September. Since the quality is greatly damaged by frost before cutting, the latest plantings are not advisable. One man can not care well for more than about 4 acres of tobacco, and usually about 3 acres is all that one undertakes, in addition to 10 to 15 acres of corn.

The tobacco is wilted in the field for a few hours and is cured in barns. Fire is used lightly and only in exceptionally wet weather. A space about 30 by 15 by 16 feet is needed for hanging the yield of an acre. The leaves are stripped, sorted, and made into hands in late fall and early winter, and sold in the open leaf markets of Lancaster, Lexington, and other near-by towns.

Hemp is produced in the county both for fiber and for seed. The acreage at present is small. Hemp was formerly grown in the county much more extensively, but as both hemp and tobacco do best on bluegrass sod, hemp has been largely abandoned, because less profitable than tobacco. However, in 1921, following poor returns from tobacco, it was again grown in occasional fields through much of the bluegrass country. So long as it is grown only from time to time, farmers can not afford to buy special implements for seeding, cutting, and breaking, but even with hand labor it is apparently a rather profitable crop.

The fiber crop is seeded thickly and makes a heavy and rapid growth. If seeded about the first of May on bluegrass sod, under favorable conditions it grows shoulder high by the middle of June. It is then past the critical period, or is "as good as made." Shaded by the heavy growth, the soil is kept open and mellow and holds moisture well. The later growth reaches to 6 or 7 feet. The plants bloom in early August, and for best quality of fiber they are cut while in bloom through a season of about two weeks. The crop is shocked to await the more favorable retting conditions of late fall and winter, when it is spread out in the field. Dew and rain soak it on the ground, dissolving the gums which bind the fiber to the bark and woody pitch or "hurds." The stalks are then dried in shock or barn and the fiber is broken out by hand.

Hemp requires a soil in a high state of cultivation and of good depth to clay. On shallow soils it starts out well, but on reaching a height of 1 or 2 feet it ceases fast growth, apparently because the taproot can not easily penetrate the clay. Hemp also requires a uniformly good soil. When some plants grow a little above others in the early stages, they retain this advantage, growing thick and "flaggy" and dwarfing the near-by plants. Neither flaggy hemp nor short hemp gives good fiber. Even where growth is less uneven, the higher plants are likely to bloom first, and a "double bloom" necessitates cutting part of the crop out of season. For these reasons hemp is best produced on the uniform Shelbyville silt loam and to some extent on the Culleoka gravelly silt loam.

Hemp is not so exhaustive of fertility as might appear. It has been grown for four years in succession in this county without fertilizer and with little decrease in yield. It leaves the land mellow. Corn following hemp is estimated to yield a fourth more than following corn in the same field.[2]

While hemp is grown for fiber in other parts of the bluegrass region and in other States, including California, nearly all the commercial supply of hempseed is produced in and near this county. Local growers estimate that about half the total supply is grown in Garrard County. The industry is not large, a total production of about 10,000 bushels being estimated as about sufficient to supply the usual demand. The seed crop is grown mainly in the bottoms of Kentucky River, but occasional fields were seen in different parts of the upland during the survey, and it is stated that some hempseed is commonly grown in the vicinity of Buena Vista.

Hemp makes its greatest growth and largest seed production on the parts of these bottom lands which are filling in, so that the soil is mellow through the 3-foot section. As a rule this condition exists in the sandy strip next the river, but at the mouths of creeks there are fields of deep, mellow silt loam occupying low bottoms, which produce equally well, and the largest hempseed farms in the county, those at the mouth of Paint Lick Creek and of Sugar Creek, are mainly of the low silt loam creek bottom land. These sandy strips and creek bottoms are mostly planted to hempseed year after year; the sloping river bank or "under bank," wherever it is not too steep, is plowed and planted to the water's edge. On these mellow soils the plants reach a height of 12 to 16 feet, with stalks as thick as a man's wrist, and branch widely, producing from 15 to 25 bushels of seed per acre.

The silt loams and fine sandy loams with heavy subsoil do not grow so large a plant and require a rotation of crops, including clover, to maintain a high state of productiveness. They are frequently planted to corn, with hemp on the river bank. On these soils hemp produces about 10 to 15 bushels per acre. In especially favorable seasons these higher bottom soils may produce a maximum of about 20 bushels per acre.

The larger yield on recently deposited soil is probably due in part to better moisture conditions, for such soil is well drained and has a

[2] A full discussion of hemp as a fiber and seed crop, by Lyster H. Dewey, published as Separate 628, from the Department of Agriculture Yearbook 1913, contains information concerning methods, improved machinery, markets, and uses, of great value to hemp growers.

large capacity for moisture, while the mellow structure favors the penetration of a long taproot.

The seed is planted in checks 4 to 5½ feet apart and thinned out, according to the distance between hills, to four to seven stalks. The best results are obtained by seeding by hand and covering with only a little soil. The staminate plants may be recognized when in bloom and nearly all of them may be cut out. The seed matures quite uniformly. It must be harvested at the right time, for overripe or frosted seed shatters. The plants are shocked up as well as may be done, and after drying the seed is beaten out on canvas and winnowed.

Seed is apparently produced with profit in the uplands. It is grown, mostly on sod, on the Shelbyville silt loam, Lowell silt loam, and Culleoka gravelly silt loam. Here the plants are usually grown in checks 3½ to 4 feet apart, with three or four stalks to the hill. They do not make nearly as large a growth as along the river. Yields are said to range from about 8 to 15 bushels per acre. Some growers state that breaking out the tip of the main stem induces greater side branching and increases yields in the upland. The crop is planted in May or June. Even the later plantings ordinarily mature well before frost. The crop is harvested mainly in October.

Hemp tends to "run out" in this country, not by losing vitality but by developing shorter internodes and consequent increase of branching. From time to time fresh stock from China is introduced. In 1921 one of the larger farms had been planted with seed grown at Arlington Experiment Farm for several years for acclimatization and selection. The owner stated that plants from such seed thrive even the first year, and that growers do not discriminate against it. Apparently seed produced from the progeny of the Arlington seed is quite generally distributed soon after its introduction, and the standard of quality thus maintained.

The industry is not regulated at all. Much of the seed is produced under contract with dealers, and while there are occasional years of overproduction, it remains on the whole a profitable crop.

There is not much care and attention given gardens and orchards in the bluegrass country, the returns for the county in 1919 averaging about $50 per farm, and in 1909 about $40. Manured gardens in the Knobs probably yield about as well as those in the limestone sections. In the bluegrass sections truck crops produce well. Potatoes yield 50 to 100 bushels per acre. Peas and beans are grown to some extent in corn. Tomatoes, sweet corn, cabbage, lettuce, and onions produce well. Watermelons are occasionally grown on sod land and marketed in the local towns.

In the bluegrass country it is the general belief that peaches and apples are very uncertain crops, and only a few trees are commonly seen on farms. It seems probable that by spraying and pruning fair yields of fruit could be obtained in ordinary seasons. Elsewhere situations and soils similar to those of the limestone uplands are considered good fruit land. In the Knobs the trees evidently produce better and orchards are more common, the climatic conditions doubtless being somewhat better.

The farms of the county are generally well equipped with good buildings, machinery, and stock. The farmhouses are usually substantial, and on the larger farms there are commonly very attractive

buildings with well-kept grounds. The stock barns are small, with little mow room. The tobacco barns are generally substantial buildings of unmatched lumber. The machinery on the larger farms frequently includes tractors, 3-horse disk plows, large disk harrows, drills, and binders. Disk harrows are popular in all sections.

The grade of work stock is good. Many mules are used for farm work. Most of the work stock is raised locally, but little or no work stock is shipped out. The cattle on farms are mostly grades of the dual-purpose or beef breeds.

While some rather definite rotation of crops is followed on most farms variations are numerous. In general they may be defined as including clover at least every fifth year. Typical rotations are corn, wheat, clover; corn, corn, wheat, clover; tobacco, wheat, clover. Following bluegrass, the land is more heavily cropped for a time. A year or two in timothy may be added to either of the first two rotations, and land may remain in timothy and clover for some time for pasture. A cover crop of rye may be used between cultivated crops; and after a cover crop of rye, tobacco may be followed by tobacco or corn.

Fertilizers have been used very little in the county. In 1919 the use of fertilizers was reported on only 7.3 per cent of the farms of the county, and on these farms the expenditure amounted to only $49.86 per farm.

Practically all the farm labor is done by the owner or renter. In 1919 about one-third of the farmers reported the use of hired labor; the total expense averaged $172.31 per farm reporting. Labor is usually hired only in busy seasons. Men without equipment prefer to grow tobacco on shares, working for wages only at other times.

The proportion of farms operated by tenants has steadily increased from 18.8 per cent of the total number in 1880 to 34.5 per cent in 1920. In renting, the use of various fields is generally specified in the agreement, and the agreements for various crops are apparently based on estimates of fair wages for producing them. House rent is sometimes considered. The tenant usually receives half the grain of the corn crop. Sod land for tobacco is generally rented for half the crop, the owner furnishing plants, sticks, and barn room.

The average size of farms in the county in 1920 was 86.5 acres. There are numerous small farms of 5 to 20 acres each near the towns and villages. In general farming sections farms of 100 to 250 acres are common. In the "sandstone" country there are many farms of 30 to 80 acres. There are very few individual holdings of 500 acres or more of farm land in the county.

The market value of farm land in the bluegrass sections is determined first by the suitability for tobacco production. Tobacco makes much larger returns per acre than other crops, and men of small means can pay for small farms best by growing tobacco. Bluegrass sod has a much higher present value than similar land which has been farmed for several years. For two or three years the returns from tobacco ranged from $500 to $1,000 per acre. It was realized, however, that this could not continue, so the price of tobacco land was not proportionate. Land values do not differ so much according to the distance from towns as according to location on pikes. Farm lands even a short distance from pikes are sold at reduced figures.

Land values vary somewhat according to the type of soil. At this time (1921) few farms are valued at more than $400 an acre, and good bluegrass land may be obtained for less than $200 an acre in most sections.

SOILS.

The soil materials of Garrard County have come from sedimentary rocks, and in the case of the upland types they have been accumulated in place through the breaking down of the various rock beds. Only in case of the alluvial soils has there been any measurable accumulation by transportation.

The forces of weathering acting on these soil materials through the ages have produced marked changes. Leaching has removed much of the more soluble salts, among them lime carbonate, from the upper layers; the growth and decay of vegetation has added organic matter; organic acids have assisted in chemical changes; and percolating and surface waters have to some extent caused the elimination of finer soil grains from the uppermost layer, causing a mechanical zonation. These and other evolutionary steps have developed the soils as they exist to-day.

The rock formations of the bluegrass plain are mainly of Ordovician age, and consist of limestone, shale, and sandstone. These different rocks occupy extensive valleys and basins and ridges in other parts of the Appalachians, such as the central basin of Tennessee and the Nittany Valley of Pennsylvania. The rocks consisting of deep beds of relatively pure limestone, commonly occupy lowland belts or basin areas. The sandstones and shales more often form associated ridges or hills.

Limestone soils are formed from the rock by very slow processes of weathering. In these soils there is very little material that may be considered as partly decomposed rock. All the material overlying bedrock is either soil, capable of supporting some plant growth, or consists of rock fragments as dense as the bedrock itself. Typical limestones are not broken down to any great extent by freezing and thawing. Sandstone, for instance, absorbs water, and on freezing may be crumbled. Limestone does not take up much water. It is decomposed mainly by the dissolving of the lime by water. The limestone contains some impurities not easily dissolved in water. These are left in place after the lime is dissolved and carried away, and go to form the soil. Thus a considerable thickness of limestone is required to produce a foot of soil, whereas in sandstone a foot of rock may form about a foot of soil.

In most of the limestone soils of the county, the dissolving waters can attack only rather limited rock surfaces, as there is little depth of broken rock over the solid bedrock. The flinty chert fragments which occur in some places may have pitted surfaces, which were a little limy, but the chert itself is a very resistant substance. The process by which these limestone soils have accumulated accounts for the relatively shallow depth of the soil, which ranges from about 3 to 5 or 6 feet.

The difference in the amount of soil material in different rocks is well shown in the sandstone parts of the county. The sandstone bed is little more than 50 feet in thickness, but the mass of soil from it is

so great that it covers the lower limestone slopes. In the sandy limestone of the Bald Hills the rock is evidently more subject to the action of frost, and a friable, sandy material, not leached of its lime, occurs interbedded with clay.

The soil material from the limestone of the county generally consists largely of clay. The unsorted material immediately overlying the bedrock is commonly a rather heavy and plastic yellowish clay. Near the surface, however, this material is sorted by water passing through it and carrying away the finer clay particles, so that a silt loam or silty clay loam surface soil has been formed. On some levels and gentle slopes the material is somewhat silty to a depth of 3 feet; but generally it is little deeper than this, and on slopes where there is normally some loss by washing, the plastic clay commonly appears within the 3-foot section. This heavy clay is retentive of water, the subsoil in cultivated fields remaining moist in rather dry seasons.

The rock formations of the inner bluegrass country occupying the northwest part of the county are of the Lexington and Cynthiana formations. The Lexington is for the most part a grayish, granular to crystalline limestone. The Cynthiana is mainly a limestone, more shaly than the Lexington. The Lexington, and to some extent, the Cynthiana, are locally called "white limestone." Both are quite pure. There are a few somewhat cherty beds, but no highly siliceous or noncalcareous rocks. These formations give rise to materials from which come mainly the silt loams of the Shelbyville, Maury, and Lowell series.

The Eden shales, occupying the north-central and northeastern part of the county are mainly of shaly, relatively pure limestone. At the top of the formation is a siliceous, noncalcareous mudstone or sandstone, interbedded below with shaly limestone. This is known as the Garrard sandstone. Material from the Eden limestones gives rise mainly to the Fairmount stony silty clay loam, but most of the Eden outcrop is covered with the Culleoka gravelly silt loam, derived from material coming from the Garrard sandstone.

The rocks of the outer bluegrass section, occupying the south-central part of the county, are mainly of the Maysville and Richmond formations. These rocks are similar and apparently are made up almost altogether of bluish or bluish-gray, shaly, relatively pure limestone or calcareous shale. They are practically free of chert, and contain only occasional beds of rock dense enough for good road material. Over these formations have developed the Shelbyville silt loam and the Lowell silt loam.

Near the margin of the basin there are relatively small exposures of younger rocks. The Bald Hills in the southwestern part of the county are underlain by beds of calcareous sandstone or sandy limestone, a very soft calcareous shale or soapstone, and rather siliceous calcareous shales. Here is mapped the eroded phase of the Fairmount silty clay loam.

The "flatwoods" near the margin of the basin are supported by a cherty, massive, brown limestone, and most of the soils of the flatwoods are derived from it. These include the Shelbyville and Lebanon silt loams and the rolling phase of the Maury silt loam. The cherty slopes were mapped mainly as Lebanon. This limestone is apparently of Devonian age. In a few places a little Devonian black shale remains in place immediately overlying the limestone.

Very slight differences in level produce changes in the character of the soil.

In the Knobs country the underlying rock is mainly the Waverly, the base formation of the Mississippian. The formation here is of noncalcareous shale, with some sandstone. The material resulting from its disintegration gives rise to the Dekalb and Tilsit silt loams. At the base of the Knobs there are narrow outcrops of the Devonian black shale, a bituminous, fissile shale, but the overlying soil appears to be derived mainly from the Waverly formation.

Soils that are similar in origin, color, and structure are classified in a soil series. Each soil series, therefore, consists of soil types that are similar in most of their characteristics but differ from each other in texture, or the relative coarseness or fineness of the surface soil. The soil type is the unit of soil mapping.

The types of the Shelbyville series have brown surface soils and a yellow to yellowish-brown moderately stiff subsoil containing varying quantities of dark-colored concretionary material. These are well-drained, residual upland, limestone soils. The series is represented in this county by the Shelbyville silt loam.

The types of the Maury series have rich-brown surface soils overlying a buff or light reddish yellow, moderately friable subsoil, more friable than that of the Shelbyville. The Maury soils are well drained, productive, easy to handle, and are less subject to erosion than the Lowell soils on account of the smoother topography and more open subsoil. They are derived from limestones containing a high percentage of phosphorus. This higher content of phosphorus in the parent rock has given rise to the principal difference between the Maury and Hagerstown soils. The Maury silt loam, with a rolling phase, is mapped in this county.

The Lowell soils are brown to yellowish brown in the surface layer, and have a yellowish, stiff, plastic, heavy clay subsoil, carrying little or no concretionary material. These are also well-drained, residual upland soils derived from limestone. They are more subject to erosion than the Shelbyville soils on account of their heavier clay subsoil. They are stiffer in the subsoil than the Cincinnati soils, contain less lime carbonate than the Fairmount soils, and less concretionary material than the Shelbyville.

The Fairmount soils differ from the Lowell chiefly in that the subsoil is more friable and the lower subsoil is much more calcareous than the subsoil of the Lowell, that is, within the 3-foot section. Owing to the steep slopes the Fairmount soils have been more eroded, and by erosion the soils are kept closer to the decaying rock than the Lowell. The Fairmount stony silty clay loam and the silty clay loam, with an eroded phase, are mapped in this survey.

The Culleoka soils are light brown to brown in the surface and yellow or brownish yellow and friable in the subsoil. Relatively soft fragments of the parent rock—a mudstone or very fine grained sandstone—are present locally in the soil and subsoil. These soils are derived from rock high in phosphorus and appear to be high in content of this element themselves. The Culleoka gravelly silt loam occurs in this county.

The types of the Lebanon series are upland soils derived from limestone. They have gray to pale-yellowish surface soils and a pale-yellow subsoil which in the lower part is mottled with gray and is somewhat compact. These soils occupy level areas which have been little disturbed by erosion. The level topography with the imperfect drainage resulting from the presence of the more or less impervious lower subsoil, probably accounts for the mottled color. The series is represented by the silt loam and a gravelly phase.

The types of the Dekalb series are derived from noncalcareous shales. They have pale-yellow to gray surface soils, which dry out to almost white, and a pale-yellow, moderately friable subsoil without gray mottling or compaction. They occupy slopes which average much steeper than those of the Tilsit soils. One type, the Dekalb silt loam, is mapped.

The Tilsit soils are much like the Lebanon except that they are derived from noncalcareous shale, occupy gentle lower slopes, and have better surface drainage. The soils average browner than the soils of the Lebanon series. The Tilsit silt loam is mapped in Garrard County.

The alluvial soils of Garrard County have been grouped in the Huntington, Pope, and Elk series.

The types of the Huntington series comprise soils composed of material washed entirely or largely from limestone soils. They are brown, friable, and well drained between periods of overflow. The Huntington silt loam is mapped.

The Pope soils are soils which have been developed where the alluvium comes from areas of noncalcareous rock, in this region chiefly from those areas of the upland soils of the Dekalb and Tilsit series. They resemble the Huntington soil, but have in this area a lighter brown soil and a yellower subsoil, somewhat stiffer and more poorly drained than the former type. The series is represented here by the silt loam.

The Elk soils are much like the Huntington in color, structure, and origin, but they occupy second or third bottoms instead of first bottoms, are not subject to overflow, and are older, with a tendency toward a more compact subsoil. The Elk silt loam occurs in this county.

In the following pages of this report the individual soil types are described in detail. Their distribution is shown in the accompanying soil map. The table below shows the actual and relative extent of each soil type:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Lowell silt loam	42,944	28.3	Huntington silt loam	5,888	3.9
Culleoka gravelly silt loam	25,536	16.8	Tilsit silt loam	5,056	3.3
Fairmount stony silty clay loam	12,992	8.7	Rough stony land	3,200	2.1
Dekalb silt loam	12,736	8.4	Elk silt loam	2,816	1.9
Maury silt loam	7,552	7.9	Lebanon silt loam	1,280	1.6
Rolling phase	4,352		Gravelly phase	1,280	
Shelbyville silt loam	10,112	6.7	Pope silt loam	832	.5
Lowell silty clay loam	8,704	5.7			
Fairmount silty clay loam	3,904	4.2	Total	151,680	.....
Eroded phase	2,496				

SHELBYVILLE SILT LOAM.

The Shelbyville silt loam typically consists of a brown mellow silt loam grading at about 8 to 12 inches into yellowish-brown or light-brown silt loam, and this at about 10 to 15 inches into yellowish-brown or brownish-yellow friable silty clay loam, which, in turn, passes at about 18 to 22 inches into yellow crumbly silty clay, containing some small black concretions and dark, friable concretionary material. The content of this dark material becomes larger in the lower part of the 3-foot section, and in places it constitutes the greater part of the lower subsoil material at certain depths.

In places the lower subsoil is slightly compact, in some spots so compact and so high in concretionary material as to resemble a hardpan. Small areas with this exceptional lower subsoil occur about 4 miles southeast of Lancaster and on the Lincoln County line between Drakes Creek and Harmon Lick Branch. Some areas show a little gray mottling in the lower subsoil. The concretions and concretionary material in the subsoil do not mean that this is a poorly drained soil. The underdrainage may not be so nearly perfect as that of the Hagerstown, but is adequate, and good yields are obtained even from those areas where the lower subsoil is comparatively compact. In some places small quantities of angular chert fragments are present in the soil and subsoil, as in the vicinity of Hammack. On the steeper slopes the soil is not so deep as it usually is on the smoother, higher situations. On the slopes there are some included small patches of Eden silt loam.

The substratum is a heavy, plastic, yellow clay, which tends to crumble on exposure. This ordinarily appears at depths of a little more than 3 feet, and in places is reached within the 3-foot section; there is evidently some shifting of the silty surface soil by erosion even on gentle slopes, and the rock is not weathered to uniform depths. The total depth of soil, subsoil, and substratum varies from about 3 to 8 or 10 feet. It is seldom that rock is reached within the 3-foot section, except along the rims of slopes, depressions, and sinks. The material of this soil is derived from limestone, which ranges from thin-bedded pure and siliceous limestone to thick-bedded limestone, often highly fossiliferous. In some localities, as about Hammack, chert is present in parts of the parent rock. Free lime carbonate has all been removed by solution, so far as revealed by the hydrochloric-acid test, throughout the 3-foot section.

This type occupies large areas on the higher gently rolling uplands and divides about Lancaster and Manse. It is also developed in the flatwoods country about Hammack, where the surface slopes sufficiently to drain well.

The type, with very little exception, has good surface drainage without much surface washing under ordinary farm treatment. Moisture conditions within the soil are also favorable. There is some underground drainage in much of the type by way of subterranean cavities. There are occasional slight depressions and well-defined but shallow sinks, which are generally without open outlets. (Pl. XIV, fig. 1.) No caved-in or open sinks were observed, though in a few places in the northwestern part of the county there are narrow openings in solid rock to underground streams. Generally a mellow soil

has accumulated to considerable depth in these depressions. Deeper and steeper sided sinks are common at some lower levels near Dix River; these interfere somewhat with cultivation, but most of them are farmed along with the rest of the land.

The underdrainage is not as good in the vicinity of Hammack as elsewhere in the type, although no hardpan is developed. In places there is more gray in the lower subsoil than is common. This is also the case in some areas due south of Lancaster. Along the Stanford Pike the type includes areas on which white oak is a more common growth, and the lower subsoil is somewhat mottled.

This soil is highly productive and practically all under cultivation. Occasional forest trees are seen; among them are black oak, red oak, white oak, poplar, ash, redbud, locust, and walnut. The principal crops are corn, wheat, red clover, timothy, and tobacco. Much of the tobacco is produced on shares by tenants. Stock farming, with the feeding of hogs, cattle, and, on some farms, sheep, is practiced in connection with the production of tobacco. Some dairy cattle are raised, but feeders are mostly purchased. There are very few dairy farms.

Corn yields 35 to 70 bushels, wheat 12 to 25 bushels, clover and timothy 1 to 2 tons, and tobacco 900 to 1,400 pounds per acre. Bluegrass thrives, but pastures are mainly of timothy and clover. Hemp is occasionally grown, yielding 1,000 to 1,400 pounds per acre.

Farms on this type are commonly larger than in other sections, containing ordinarily between 100 and 250 acres. Common rotations are (1) corn, wheat, clover, timothy; (2) corn, corn, wheat, clover, timothy; (3) tobacco, corn, wheat, clover; (4) tobacco, wheat, clover. Bluegrass sod gives the higher yields for several years after breaking. Clover sod is nearly as good, though not so enduring. Fields of timothy sod are seldom cultivated two years in succession. Yields are said to vary more in different rotations than according to the season.

Commercial fertilizers are very seldom used, and then mainly to restore heavily farmed land; as in one case where a former owner produced 10 crops of wheat in succession, and trouble was experienced in getting a stand of clover. Ordinarily, a good stand of clover is obtained without fertilizer, and heavily farmed fields are said to regain quickly their former good tilth and productiveness when clover is grown. It appears probable that the soil contains phosphorus and the other mineral plant-food elements in sufficient quantities to produce well for a long period without commercial fertilizer, under the prevailing farming methods. Commercial fertilizer is apparently more commonly used on the land about Hammack. The Shelbyville silt loam is valued at about $200 to $300 an acre.

An imperfectly drained variation of the type includes a few areas, mostly overlying sandstone or rather dense shale at shallow depths. It consists of light-brown to brown silt loam, passing at about 6 to 8 inches into lighter brown or yellowish-brown heavier silt loam, grading into yellow silty clay loam of friable structure, which passes abruptly into yellow, friable silty clay, showing gray and sometimes rusty-brown mottling and containing in places some friable limonite-yellow material. The gray mottling usually increases with depth. The lower subsoil consists characteristically of rather plastic clay,

mottled gray or bluish gray and yellow or pale yellow. This stiffer lower subsoil is of an impervious nature and causes the soil to have poorer drainage than the typical Shelbyville silt loam. In places there is much dark concretionary material above the stiff clay layer, forming a compact hardpan layer, that interferes with the drainage of this soil. This soil approaches closely in character the types of the Colbert series.

Several areas in the eastern part of the county, one about 1 mile west of Cartersville, one one-half mile northwest of Hammack, and another 1½ miles south of Point Leavell, have the characteristics of the Hagerstown silt loam, and would have been mapped separately if more extensive. Here the surface is smooth and the drainage good.

Some of this soil in these areas has been farmed heavily, without regular production of clover. On such farms, acid phoshpate or mixed fertilizers are used to some extent, mostly for clover. Other farms give good yields of all crops, including tobacco on sod, without fertilizer. Near Hammack yields of 1,500 to 2,000 pounds of tobacco per acre are reported. In a hard-used field of Hagerstown silt loam one-half mile southwest of Hammack, consisting of brown to light-brown silt loam grading into brown or slightly reddish brown silt loam, and this into brownish-red or buff-colored clay moderately friable and containing some dark concretions, the soil was dry and very hard and had the appearance of having had its organic supply greatly reduced by being cultivated without rotation or incorporation of vegetable matter. This deficiency apparently was the cause of the very unfavorable, hard structure. Cowpeas and clover undoubtedly would restore the soil to a favorable condition. Lime and acid phosphate probably could also be used with good effect.

The table below gives the results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the typical Shelbyville silt loam:

Mechanical analyses of Shelbyville silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
391309	Soil, 0 to 15 inches	0.9	2.3	0.9	2.1	5.5	69.2	19.3
391310	Upper subsoil, 15 to 28 inches	.9	2.0	.8	2.1	5.3	43.9	45.1
391311	Lower subsoil, 28 to 36 inches	2.0	2.8	1.0	3.0	7.2	56.7	27.5

MAURY SILT LOAM.

The typical Maury silt loam is a rich-brown, mellow silt loam underlain, at about 12 to 15 inches, by yellowish-brown to buff-colored friable silty clay loam, which passes at depths ranging from 15 to 28 inches into buff-colored or slightly reddish yellow, moderately friable silty clay. Some included areas are yellower and stiffer in the subsoil, but those of redder hue are considered more representative of the type. Some areas in their physical appearance approach the characteristics of the Shelbyville silt loam, but chemical analyses show a very much higher content of phosphorus in the typical area

near Camp Dick Robinson. The surface also averages much smoother than that of the Shelbyville. The boundary between this soil and the Shelbyville could not be drawn everywhere with sharpness.

The type occurs in the northwestern part of the county, lying mainly west of a line drawn through Marksbury and Bryantsville, and thence northward through Toddville to the north county line. The topography of the Camp Dick Robinson section is undulating to very gently rolling, with some almost level areas. The northern extension is more rolling. The soil has good surface and internal drainage. It is easily tilled, particularly where the organic matter has not been depleted to the extent of causing the soil to clod.

The Maury silt loam is used for the same crops and is handled in essentially the same way as the Shelbyville silt loam. Larger average yields probably may be expected from this type, and with its high content of phosphorus it may be looked upon as a soil of unusual durability. The material is derived from a bluish limestone (Trenton). This limestone carries a relatively high content of phosphorus, and this characteristic of the parent rock has much to do with the differentiation of the Maury soils from Hagerstown soils, which they closely resemble physically.

Maury silt loam, rolling phase.—The Maury silt loam, rolling phase, is a deep-brown, mellow silt loam, grading at 10 to 15 inches into reddish-brown friable silty clay loam, which passes abruptly into reddish-brown or brownish-red crumbly clay containing a few small black concretions. Areas of this phase occur both in the northwestern part of the county and in the flatwoods in the south-central part. Some of the phase in the northwestern part is a little stiffer and yellower in the lower subsoil. Patches of this kind of soil were included on account of their small size. In places also the upper subsoil is reddish and the lower subsoil yellowish—that is, in patchy areas.

The topography is smooth to gently rolling. The drainage conditions are good, and there is very little loss of soil by washing. Nearly all the phase is under cultivation.

In the northwestern part of the county the phase occurs in association with typical Maury silt loam and soils intermediate between them in color and content of concretionary material. The rolling phase apparently overlies rock beds which differ from the rest of the formation sufficiently to give rise to the redder more crumbly clay subsoil. The surface soils are very similar. They are farmed in the same way, and the range of crop yields is about the same. Farmers do not note any marked differences between them so far as productiveness goes. The more rolling topography makes the phase somewhat less desirable than the typical soil, but the difference is not great.

LOWELL SILT LOAM.

The typical Lowell silt loam is a brown, mellow silt loam, underlain at about 6 to 10 inches by brownish-yellow or yellowish-brown friable silty clay loam to silty clay, which passes quickly into yellow or brownish-yellow plastic, heavy clay that is sticky when moist. The lower subsoil is greenish yellow in places or slightly mottled pale yellow and yellow, the yellow having a greenish cast. The upper subsoil also has a greenish-yellow color in places. Here and there the upper subsoil contains some friable concretionary material and

also some small concretions, but the presence of such material is by no means typical. Where it is present the material of the layer in which it occurs is inclined to be a little compact, but more friable when loosened fragments are mashed between the fingers than in case of the subsoil clay not containing concretionary material.

In all cases the lower subsoil of the typical soil is much more plastic than any part of the subsoil of the Shelbyville silt loam. The main difference between the Lowell and Shelbyville is (1) that the former characteristically is a slope soil while the latter is relatively smoother, and where associated with the Lowell occupies the upper slopes and the tops of the divides; and (2) the subsoil of the Lowell is a much heavier clay than that of the Shelbyville and contains much less concretionary material.

In some places, as in the section northeast of Buena Vista, there is considerable Lowell silt loam, which has a reddish tinge either in the soil or upper subsoil or in both, which makes the type resemble the Hagerstown silt loam; but the subsoil is yellow or yellowish-brown, plastic, heavy clay in no respect similar to the subsoil of the Hagerstown. Some chert fragments also are found in the soil and subsoil of some areas in this locality.

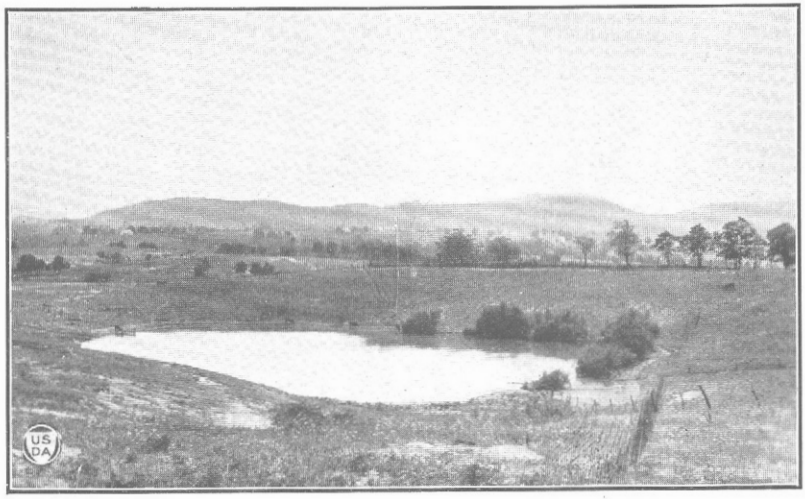
The total depth to rock is somewhat variable. It averages less than that of the Shelbyville, generally running from 3 to 5 or 6 feet. Bedrock is reached in places, even on rather moderate slopes, in the lower part of the 3-foot section. Generally such shallow soil occurs in narrow strips along the rims of depressions or hollows and along drainage ways. Shallow spots occurring on rather gentle slopes generally indicate the presence of a somewhat denser or more solid underlying rock bed. But the average depth of soil of the type does not vary greatly in different formations or in different parts of the county.

The depth of the surface soil also is variable. Apparently most of this variation is the result of washing in cultivated fields. It varies from farm to farm, but on many farms there are numerous spots washed to a silty clay loam or heavier soil. The soil and subsoil are nearly free of rock fragments.

This type occupies the greater part of the south-central part of the county and is extensively developed near the junction of Kentucky and Dix Rivers. It occupies the slopes and rolling country of the limestone formations, where Shelbyville silt loam occupies the less rolling surfaces. The topography is rolling to strongly rolling.

The surface drainage of the Lowell silt loam is good throughout, and the run-off is rapid enough to cause washing on unprotected land. Moisture conditions within the soil are good. In cultivated fields the clay subsoil is moist in rather dry seasons, and where the surface soil has good depth the yields are not reduced appreciably below those on the deeper limestone soils; consequently where the slope is moderate, soil of this type is considered equal in value to the Shelbyville. As a rule, however, farms on this soil include some strongly rolling land on which the heavier farm tools are not easily operated. And while pasture lands are broken at intervals and are now more generally of timothy and clover than of bluegrass, the greater part of many farms on this type is or should be in pasture.

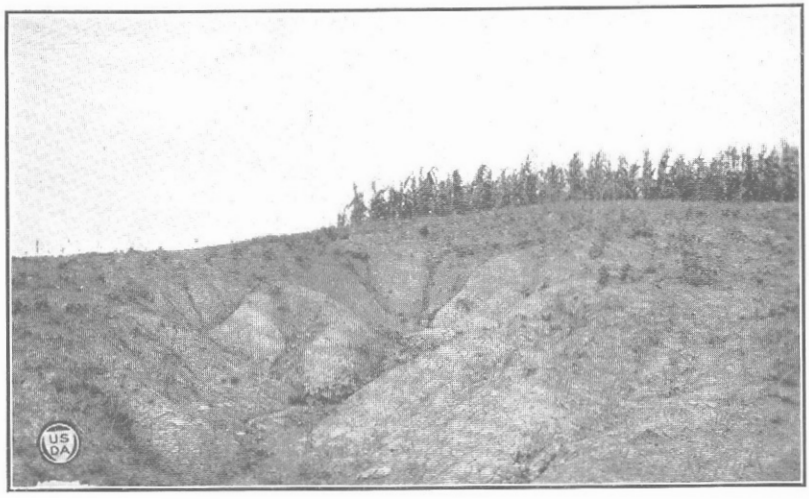
Crops are rotated as on the Shelbyville silt loam. Two cultivated crops are seldom grown in succession, except on bluegrass sod. Yields



S. 11222

FIG. 1.—SINK HOLE IN LIMESTONE SOIL

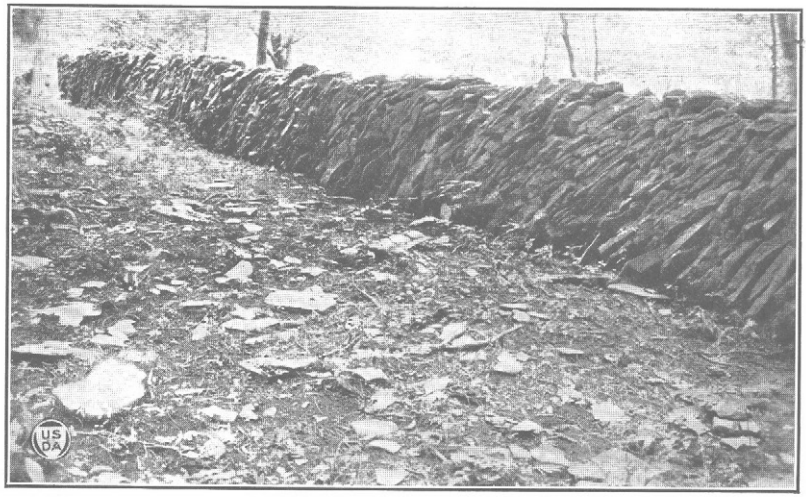
Noncalcareous shale hills, occupied by Dekalb and Tilsit soils, in the background



S. 11221

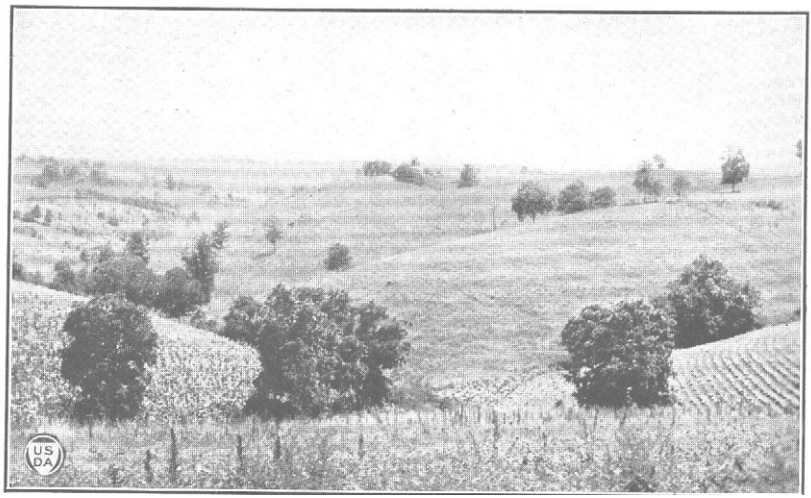
FIG. 2.—ERODED LAND, RUINED BY SLOPE CULTIVATION WITHOUT TERRACING

This land is now adapted to sweet clover. Corn on uneroded upland level



S. 11203

FIG. 1.—STONE FENCE BUILT OF LIMESTONE SLABS



S. 11232

FIG. 2.—TOPOGRAPHY OF CULLEOKA GRAVELLY SILT LOAM

are about equal to those of the Shelbyville. Tobacco is more commonly grown on this type than on the Shelbyville. Some consider that the sloping surface gives better drainage conditions for tobacco; others maintain that bluegrass sods on each give about equal yields, and more of this type has been in bluegrass until recent years. During the period of high prices there has evidently been extensive breaking of bluegrass sods, even on rather steep slopes. Many of these slopes should be returned to bluegrass.

The shallow surface soil of many fields in this type and the wide occurrence of similar soils washed to a silty clay loam texture call attention to the need of care and moderation in the use of this soil to insure that it will remain surfaced with a mellow and productive silt loam. The present surface soil is the product of ages of soil formation under a forest cover, and its renewal is so slow that this is scarcely measurable. This soil is naturally so productive that its conservation is of special importance. The short rotation, with only one cultivated crop on clover sod, guards against rapid washing and is rather generally practiced. It is fortunate that the short rotation is about as profitable as a longer one. Many farmers, however, grow a second crop of corn on rotted sod which can not hold the soil against erosion during heavy rain.

Deep plowing is generally practiced. The deeper layer of broken soil takes up rainfall faster and longer, so that the run-off is considerably reduced. The rows of cultivated crops are also run more or less along level lines, where this may be done without having many short rows.

However, heavy rainfalls wash all cultivated slopes more or less, and the loss can not be made good. In the Piedmont hills of the States along the Atlantic there are wide stretches of country in which the fields are nearly all protected by terraces or banks built up to carry away the run-off on easy grades. These lands were farmed for many years without terraces and many are badly washed. It would have been a great saving to have built terraces in the first place. Farmers there have found that while there is of course some disadvantage in working along terraces, it is largely outweighed by the better stand on smooth unfurrowed surfaces, and in the long run is of minor importance. It is believed that if terracing were tried out in this county on hilly soils which are already worn rather shallow, its advantages would be so apparent that it would become common. These terraces are banked up along the hillside with a slight even fall to the heads of hollows on nearly the same lines on which corn rows are commonly planted. On gentle slopes the broad Mangum type of terrace may be employed, in which case the entire field may be plowed and cultivated.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Lowell silt loam:

Mechanical analyses of Lowell silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
391323	Soil, 0 to 8 inches	1.3	1.6	0.5	1.4	4.6	59.2	31.4
391324	Subsoil, 8 to 36 inches	.4	.7	.3	2.6	5.9	34.4	55.7

LOWELL SILTY CLAY LOAM.

The Lowell silty clay loam represents essentially eroded slope areas which probably consisted formerly of Lowell silt loam. The surface soil consists of yellowish-brown to light-brown silty clay loam, which passes at from about 1 to 6 inches into yellow, plastic, heavy clay, in places showing a greenish cast in the lower subsoil. In many places there is a thin surface mantle of silt loam of brown color and smooth structure like that of the soil of the Lowell silt loam. This ranges anywhere from about 1 to 4 or 5 inches in depth. In dry weather the surface of the heavier soil cracks slightly. Locally the type is sometimes spoken of as clay land, and in fact it includes clay patches where erosion has been most severe.

Many slopes have been badly eroded, with incipient shallow gullies here and there and deep gullies covering much of the area of some parts of the steeper slopes. (Pl. XIV, fig. 2.) Some of the most severely eroded areas would be difficult to reclaim, having passed pretty well beyond the point of practicable reclamation. Probably many or all of these eroded slopes could have been avoided either by the timely construction of terraces or by use of the land only for grass.

The depth to bedrock averages less than in the silt loam, and in many places it is reached within the 3-foot section. In places the soil contains fragments of limestone, calcareous shale, and chert.

Much of the type is used for cultivated crops. Small patches, farmed in connection with the silt loam, produce good yields of corn and clover, so that little indication of the shallowness of the soil may be given in ordinary seasons. In dry seasons yields are reduced. The larger areas of this soil are commonly not in good tilth, and stands of clover are difficult to obtain. In a number of fields with a fairly uniform silty surface, good stands of red clover and other crops were seen.

Once the soil of the Lowell silty clay loam is in good tilth, mellowed by clover, subsequent stands of clover may be obtained with little difficulty. Bluegrass forms a fairly good sod, except in the shallow and most clayey spots and fields. Sweet clover is seeded on much of the heaviest soil. It does not usually make rank growth, but is of value, for it seeds and persists, and the better stands hold the soil well. All crops, however, are subject to drought, even on the better variations of the type, and the soil is difficult to cultivate.

There was included with this type an area lying north of Toddville, derived from the Eden formation, in which the soil is the Fairmount stony silty clay loam. The surface soil of this area is a silt loam to silty clay loam quite uniformly approaching 6 inches in depth. Most of the stones have been removed. It is said to be about as productive as the silt loam, except in drier seasons, and is altogether a good soil.

FAIRMOUNT STONY SILTY CLAY LOAM.

The surface soil of the Fairmount stony silty clay loam is typically a dark-brown to dark yellowish brown heavy silt loam to silty clay loam from 3 to 8 inches deep. This is underlain by heavy plastic clay, yellowish brown, yellow, or somewhat greenish yellow in color. Bedrock commonly occurs at 3 to 5 feet, and outcrops in places. The

type has a moderate to high content of large and small slabby limestone fragments. (Pl. XV, fig. 1.)

The depth of soil and amount of loose rock is variable throughout, so that tilled fields, forest, and permanent pasture occur alternately. It is most extensively and typically developed in the lower valleys of the sandstone country. It is here derived from the lower members of the Eden formation.

The land is hilly and over much of it the slopes are steep. A part is in forest of oak, beech, locust, walnut, maple, and other trees. All except the more stony areas of cleared land are cultivated at intervals. The soil is generally productive. Corn and clover are the principal crops. Corn yields 30 to 50 bushels per acre, depending largely on the season. Corn is produced for two years, and the land is then seeded to clover in rye or wheat. The small grain may be seeded sparingly and not cut. After a period of cultivation, the land may be seeded in clover and timothy for pasture, and bluegrass allowed to take possession. Bluegrass thrives on these hills, forming as good pasture as on the deeper soils, except where bedrock is near the surface. It appears to be especially productive on north slopes, owing to greater average depth of soil and less direct exposure to the sun. Bluegrass enriches the land, and sod fields give good yields for a period of years. Red clover thrives and produces well, and the yields of tobacco and other crops may be maintained by frequent seeding to this legume. Much of the clover on this type is pastured, but on the less stony fields it is harvested. Tobacco is grown to some extent. On bluegrass sod it yields well in favorable years, but in dry seasons may not yield more than 700 pounds.

The small areas of this soil within the Lowell silt loam represent naturally thin or carelessly farmed land. Along the heads of hollows the slopes are generally steeper, and the run-off greater and more rapid than elsewhere, so that shallow and stony soils are produced. Many of these small areas are used for woodlots, black locust growing in thick clumps and bluegrass occupying the open places. Others are farmed in connection with the silt loam and produce well except in dry seasons.

More or less shallow stony pasture land along the river cliffs in the northwestern part of the county was included in this type. Even on rather gentle slopes the soil is shallow along these cliffs. The soil is variable in texture, but is mostly a heavy silt loam to silty clay loam. In places the subsoil is reddish brown in color, but it is heavy and plastic and altogether the soil is similar to the more extensive typical soil. Bluegrass thrives everywhere except on the heaviest and shallowest clayey soil.

On the areas overlying the Eden formation the loose stones are in many places scarcely numerous enough to make up a stony soil. These loose stones are generally left in the field, as are the fragments of sandstone. But while sandstone breaks and crumbles when struck by the plow, limestone fragments throw the plow out and make for poor, patchy plowing. Where these stones are too numerous to be hauled away, the land on the steep slopes may be considered too stony to farm, because the shallow plowing induces destructive erosion. Good bluegrass pasture is too valuable to be destroyed in this way.

FAIRMOUNT SILTY CLAY LOAM.

The surface soil of the Fairmount silty clay loam is mostly a brown silty clay loam, 2 to 6 inches deep, overlying yellowish-brown, plastic clay. This passes abruptly at varying depths into bright-yellow or greenish-yellow, calcareous, granular, disintegrated rock material, rather loose in places, and having the feel of a fine sandy loam. This material may in turn pass abruptly into plastic clay or a clay containing enough disintegrated rock material to have a sandy nature. More solid bedrock is reached at depths of 2 or 3 feet.

This type is derived from interbedded calcareous shale and a grayish or yellowish thin-bedded sandy limestone or highly calcareous fine-grained sandstone, with some soft calcareous "soapstone."

The type is not very extensive. It occurs most commonly in a section to the west of Hammack, where, with its eroded phase, it occupies a considerable area known as the Bald Hills. It also is developed in the vicinity of Cartersville and in a few areas south of Hyattsville. The area 1 mile north of Cartersville and those south of Hyattsville consist largely of a silt loam surface soil overlying a good depth of clay, the friable sandy material appearing only in the lower subsoil. This is good bluegrass soil. Elsewhere the surface soil is shallow, including a good deal of clayey surface soil, and bluegrass does not thrive. In many fields sweet clover, lespedeza, and some native grasses form the only growth, and this growth is rather light.

This type is mostly in pasture and is farmed only in patches. Red clover, tobacco, and corn are grown to some extent. Sweet clover is established over practically all this country. It does not generally make a heavy growth, but seeds well and perpetuates itself. Much of this land could well be used for the production of black locust and other timber.

Fairmount silty clay loam, eroded phase.—The eroded phase includes eroded areas closely associated with the typical Fairmount silty clay loam, and some of the hills lying in the vicinity of Sweeney. The country occupied by this soil is known as the Bald Hills.

Not all the surface is eroded, but there are numerous shallow eroded areas of unproductive soil and dry gullies. There is a scattering growth of native grasses, but not much bluegrass. Some areas formerly cultivated have been washed down to bedrock. A few patches of corn were seen on the less severely washed areas. Sweet clover does well where there is a considerable layer of soil and grows scatteringly on the more severely washed areas. There is some tendency for frosts to uproot the plants. The soil material is so susceptible to erosion under cultivation and is so shallow that it is of little value for agriculture. Much of it could best be used for the production of black locust and other trees.

CULLEOKA GRAVELLY SILT LOAM.

The Culleoka gravelly silt loam is a light-brown to brown mellow silt loam, grading at about 5 to 18 inches into brownish-yellow or yellow friable silt loam, which either extends to bedrock without much change or passes into yellow friable silty clay loam. The structure of the surface soil in the average dry field condition is slightly

fluffy, and the type is very easy to cultivate in spite of the abundance of angular rock fragments present.

The parent rock is a local development within the Eden formation, occurring extensively in Garrard County and designated as the Garrard sandstone. This formation is composed of various strata, including a fine-grained sandstone or mudstone, soft shale, and some interbedded slabby limestone. Tests with hydrochloric acid would seem to indicate that the soil, subsoil, and weathered rock are free of lime carbonate; a laboratory examination showed considerable lime in the unweathered material of some of the strata.

Where the sandstone outcrops on the upper slopes, the fallen or colluvial material covers the lower slopes to considerable depths. On north slopes the soil averages deeper, possibly because of deeper freezing in winter and a resultant increased capacity for absorption by the loosened material. There are included in the type, as mapped, some areas in which the soil is Culleoka, but the subsoil is a plastic yellow clay derived from limestone or shale, and more or less "mixed land," in which patches of limestone soil appear at the surface.

There is usually a high content of large and small rock fragments in the soil. These may interfere somewhat with cultivation, but they do not anywhere prevent it. While the rock holds up well above ground, it breaks down completely and quickly in the soil, and usually a 3-foot boring passes through more or less of this freshly decomposed material and through soft partly decomposed fragments of the rock.

The type is extensive, occupying most of the north-central and northeastern parts of the county, and occurring to some extent near Dix River west of Lancaster. It occupies very hilly country. The main ridges are narrow and extend at nearly even levels for long distances, forming high headlands along the Kentucky River. Side ridges extend well out to the tributary streams, with deep, steep-sided hollows intervening. The main ridges are more or less winding, and the subordinate lateral ridges slope down from the crest of the main ridges in all directions. All are flanked with steep slopes. (Pl. XV, fig. 2.)

The Culleoka gravelly silt loam is very productive, and practically all of it is under cultivation. There are scattered trees of black locust, honey locust, walnut, poplar, ash, oak, hickory, maple, elm, sycamore, box elder, and redbud (or Judas tree).

Moisture conditions are very good. The soil crusts very little, and the porous structure obtains to such depths that the soil absorbs and holds large quantities of rainfall. The porosity is increased by the rock fragments in both soil and subsoil, and the soil is so highly absorptive of rainfall that erosion is slow, and some very steep slopes are cultivated with apparent safety.

Corn, red clover, tobacco, and wheat are the principal crops. Some hogs and a few dairy or dual-purpose cattle commonly are kept. The farms are generally small, ranging from 5 or 10 acres to about 80 acres, and tobacco is the principal source of income. Tobacco yields about 1,000 to 1,200 pounds, corn about 40 to 60 bushels, clover 1 or 2 tons, and wheat 15 to 25 bushels per acre. Little of the type is in grass. Bluegrass grows, though not as luxuriantly as on the limestone soils.

The land is farmed in short rotations. Formerly cultivated crops were grown in two consecutive years but only one is now grown as a rule. Common rotations are corn, wheat, clover; tobacco, wheat, clover; corn, corn, wheat, clover. Wheat is probably the principal small grain, but rye is used a good deal. Timothy is sown occasionally and produces well, but is not generally needed for hay in this type of farming, and the clover sod is more productive. Fertilizers are not used on any crops.

Red clover thrives on this soil, especially in the short rotation now generally practiced. A satisfactory stand is practically certain on account of the good tilth maintained. The crop is free from disease, and produces and seeds well. Usually a bushel of seed is used on 6 or 8 acres. Small grain is commonly sown with clover, but some farmers only broadcast rye lightly on the steepest slopes, and do not cut the rye or clover the first season, but pasture to some extent. More or less clover is pastured the second year; it is never overstocked, and furnishes a considerable supply of green manure on breaking.

It is advisable to have a crop on the land through the winter. Rye is used as a cover crop when two cultivated crops are grown. This may be pastured to some extent.

The hillsides are plowed with a hillside plow. Some fields along the ridges can be plowed with ordinary turning plows. Binders are used also in these fields, but the grain on the steeper slopes is cut with the platform on the lower side where possible. Some of the small grain is cradled. Cultivated crops are worked with 1-horse double-shovel plows.

This is considered the best tobacco land in the county; indeed, it is held by some to be the best in the bluegrass region. It does not give exceptionally heavy yields, but through its especially good moisture supply it maintains steady growth through dry spells and gives high average yields, which on clover sod seldom fall much below 1,000 pounds per acre. This steady growth itself contributes to a good quality of leaf. In general the tobacco has a body similar to that of limestone Burley, but dealers state that it has a characteristically fine texture. It is said that this tobacco is used to some extent as wrapper for plug and twist. In recent years it has commanded a premium on the market.

The land is valued generally at $150 to $250 an acre. Higher prices have been paid in speculative years.

The labor of farming such steep slopes is lessened by the good structure and depth of the soil. Hillside plows give easy draft. Two or three harrowings insure a good seed bed. Tobacco is so largely grown by hand labor that it is produced with little more labor than on gentler slopes. The difficulty of harvesting crops is such, however, that the cornstalks are generally plowed down, and clover is pastured on the more inconvenient hillsides.

Ordinary rains do not wash these slopes to any great extent, but heavy rains cause some surface erosion. Very few deeply washed and gullied fields are seen, however, for the soil is deep and the washed surface is smoothed in cultivation. The whole hillside is commonly plowed the same season, for plowed land absorbs more rainfall than clover land. Nearly all the plowing is 8 inches deep and some is

deeper. It is generally understood that the surface is being lowered by slow erosion more rapidly than the rock is being weathered, but up to the present the loss has not affected crop yields to any great extent, for the lower soil is invariably productive. One exceptionally badly gullied field had been reclaimed by plowing in the gullies; the owner stated that tobacco grew well in the bottoms of 3-foot or 4-foot gullies. The soil is not so deep below the outcrop of the sandstone formation; and on soil overlying sandstone rock the course of former gullies can be traced in places by the smaller growth of plants.

Some farmers are of the opinion that terrace banks could not well be built up of the mellow soil so as to hold on these slopes, but this probably represents an impression not supported by experience. There is no evidence of any attempt at real terracing. If the deep, open, sandy soils of high porosity, such as the Norfolk sand and sandy loams and the Orangeburg sandy loam of the southern States, can be efficiently terraced, and precisely this has been done by a great many southern farmers, there would seem to be no good reason why equally efficient results could not be had on the Culleoka gravelly silt loam. It may be suggested that at least the run-off from the wider, even ridges could be carried to the heads of ravines by terraces near the brow of the hill, and that the shallow soil along the slopes below the sandstone outcrop could well be built up into solid terrace banks and sodded with bluegrass.

LEBANON SILT LOAM.

The Lebanon silt loam is typically a light-brown or grayish-brown silt loam, passing at 3 to 5 inches into pale-yellow silt loam, and this at 20 to 24 inches into pale-yellow silty clay loam to silty clay. The lower subsoil is a moderately compact pale-yellow silty clay loam or silty clay, mottled with gray, the gray frequently increasing with depth. In places some gray is present higher up in the subsoil. Fragments of the subsoil crush readily. Small fragments of chert are present in the subsoil, being more common in the lower subsoil, and in places they are also found in the soil. Some fragments are fairly large. The soil dries out to a light-gray color. The compact lower subsoil is locally referred to by some as a "pan," meaning a hardpan.

The type is not extensive in the county. It occupies a part of the flatwoods in the vicinity of Hammack. The surface is essentially flat. The forest growth is typically of oak, sweet gum, sassafras, and other trees, but the growth is not large.

Both surface and internal drainage are imperfect. In places the compact subsoil acts like a hardpan, checking the downward movement of water. Water stands on the surface after rains, and the soil after a wet season remains soggy for some time. Physically the type resembles the Tilsit silt loam. The presence of chert indicates that it is in part a product of calcareous rock.

Redtop is a common meadow and pasture grass. Corn gives poor yields, especially when the season is late or is very rainy. As this is a late soil, the methods of improvement should include better drainage, which probably can be done best by open ditches. The supply of organic matter in the soil should be increased by applying manure

or turning under such crops as cowpeas and clover. Applications of acid phosphate undoubtedly would increase the yields. It would seem that redtop and wheat would give better average results where phosphate is applied. Lime would probably help to get better crops of clover.

Some small areas of Colbert silt loam have been included with the Lebanon silt loam on account of their small extent. The Colbert soil is somewhat lighter in color than the Lebanon. It consists of a surface layer of gray silt loam, which on drying assumes a light-gray to whitish color and floury feel. This is underlain at 5 or 6 inches by mottled yellow and light-gray or whitish silt loam, which grades at about 10 to 14 inches into mottled yellow and bluish-gray friable silty clay, underlain at 24 to 30 inches by mottled yellow and bluish-gray, tough, heavy clay. Small chert fragments are present in the soil and subsoil in places, and small black concretions are noticeable in the soil. No effervescence with hydrochloric acid was noted; in fact, the soil is probably in an acid condition.

This included Colbert soil is of small extent. It occupies imperfectly drained flats in the flatwoods. The principal areas, each containing only a few acres, lie about one-half mile northwest and 1 mile west of Hammack. Two other small areas occur southeast of Hammack and southwest of Point Leavell.

Crops are very poor on this soil. Some corn is grown, and in places there is a growth of redtop and native grasses with some lespedeza. By digging drainage ditches and growing cowpeas the soil could be made more productive. Acid phosphate would probably prove helpful to all crops, and lime would assist with clover. Grass and wheat may prove the most profitable crops in the long run.

Lebanon silt loam, gravelly phase.—The surface soil of the Lebanon silt loam, gravelly phase, is typically a grayish-brown (gray when dry) silt loam, passing at about 2 or 3 inches in timbered areas and at 5 or 6 inches in plowed fields into pale-yellow silt loam. This is underlain at variable depths by yellow or pale-yellow, stiff, heavy clay. In places gray mottling is present in the lower subsoil, even on slopes, and red mottling is also present in places, giving the lower stiff clay a mottled red, yellow, and gray color, making this part of the soil section resemble the subsoil of the Susquehanna soils of the Coastal Plain region. There is an abundance of angular fragments of chert, 2 to 4 or 5 inches in diameter, through the soil and subsoil.

On a slope below the Lebanon silt loam at Hammack the soil consists of grayish-brown silt loam, passing at 5 or 6 inches into pale-yellow silt loam, and this at variable depths into pale-yellow silty clay loam to silty clay, ranging from friable to slightly plastic, and mottled more or less with gray and in places with rusty brown or yellowish brown. It includes angular chert fragments in quantities varying from small to very large. In some areas there is little erosion, but some cultivated fields have been rather severely eroded, especially where the gravel content is low.

Small areas of a brown to yellowish-brown silt loam overlying yellow, friable silty clay loam or silty clay, passing downward into stiff red clay mottled with yellow and gray and containing chert fragments, occur on slight rises and to some extent on slopes. The red mottled subsoil is not typical of the Lebanon soils.

The phase is not extensive in the county; it occupies areas along the outcrop of the massive limestone which supports the flatwoods. It is a variable soil and is developed mainly in hollows where the Lebanon silt loam occupies the flat, higher, adjacent country.

The phase supports a growth of small oak and other trees. The ordinary yields are not high. The soil needs organic matter and possibly acid phosphate. Improvement undoubtedly would result from growing cowpeas and clover.

DEKALB SILT LOAM.

The surface soil of the Dekalb silt loam, when dry, is typically a gray silt loam with a floury feel, grading into pale-yellow friable silt loam, which extends to depths of 10 to 20 inches. The subsoil is a yellow, friable silty clay loam or silty clay, which is somewhat compact in places. The lower subsoil of some included areas is slightly mottled with gray, even on very steep slopes, but the conspicuous mottling of the Tilsit soils is wanting. There is an abundance of thin clayey shale fragments in places, and on the upper slopes there are some fragments of thicker sandy shale and sandstone. Some of these areas would have been mapped as Dekalb shale loam if of sufficient extent. There is no evidence of lime carbonate in the soil or subsoil or in the unweathered parent shale.

The type occupies the steep slopes and ridges of the Knobs in the southern end of the county. The Knobs rise abruptly from the low country, with very few foothills, and reach elevations of 300 feet above the plain. The streams have cut down to the plain level, reducing the higher country to a very hilly topography. The slopes are high and steep, and bedrock is frequently exposed in ledges and cliffs on the shoulders of the Knobs. The ridges are very narrow and are broken by many gaps.

The forest growth comprises various oaks, hickory, and other hardwoods. White oak and red oak are common; there is some chestnut oak, but very little chestnut. The second growth on cut-over areas in places consists of scrubby oak and sassafras. Some small pines grow where the soil overlies the Devonian black shale formation, which is exposed in places at the base of the Knobs.

Some rather steep slopes are cultivated. Corn is the principal crop. Fair yields are obtained for a few years after clearing, but later they decline rapidly, and the land is commonly left in redtop. Sassafras, blackberry bushes, greenbrier, and various weeds soon overspread such land and are so persistent that the pastures are generally abandoned to them. Altogether the labor of clearing the land and producing crops on the steep slopes is so great that farming is not very profitable. Apples and peaches produce quite regularly in the Knobs and would probably prove more profitable in the long run than corn.

Except for fruit production, this soil represents essentially forest land. Most of it, the roughest part, is suited only for forest. Some crossties and telephone poles are taken out. The forest has been pretty well cut over, but there is usually a good stand of young trees. Organic matter could be supplied with good results in the cultivated areas, and undoubtedly acid phosphate would help increase the yields. Potatoes, with liberal fertilization, should give fairly good yields.

TILSIT SILT LOAM.

The surface soil of the Tilsit silt loam in forested areas consists of 1 to 2 inches of light-brown or grayish-brown silt loam of floury texture when dry, passing into very pale yellow silt loam of similar structure, which shows some gray mottling at depths ranging from about 12 to 18 inches. This is underlain at about 18 to 24 inches by pale-yellow silty clay loam, mottled with gray, and having a somewhat compact structure. Some shale fragments are present in the subsoil. According to field tests there is no lime carbonate in the soil, subsoil, or parent shale.

The type occurs on more or less gradual lower slopes along the main streams traversing the Knobs country, and in places at the margin of the adjacent plain country. Some areas form a part of the "flatwoods" section, and the remainder is not much above this level. The surface generally has sufficient slope to give fair to good surface drainage. The underdrainage is probably retarded somewhat by the compact lower subsoil, but it is not very poor, except in some unusually flat situations. The soil is quite uniform, apparently being derived entirely or largely from the fissile shales of the Waverly formation, even where it overlies the black shale.

The type is not naturally very productive, but most of it is farmed. Corn and redtop grass are the principal crops, and on many farms practically no other crops are grown. A few cattle and hogs, and in some places sheep, are kept. The Knobs furnish summer range. Many of the farmers find employment in lumbering also.

Corn produces about 15 to 25 bushels per acre. Redtop yields about a ton of hay per acre; it is also a fairly persistent pasture grass, though pastures must be kept clear of sassafras, greenbrier, and other undesired growths. Corn is produced on redtop sod, enriched with what manure is available, and on some farms with small applications of commercial fertilizer. By the same methods a good stand of red clover may be obtained. Very little small grain is produced. Grass is often seeded without a cover crop. Oats are sometimes cut for hay. Cowpeas thrive and enrich the land, and might well be more commonly grown. Tobacco may be grown by the use of fertilizer, but is not a common crop. Lespedeza appears in meadows and pastures to some extent. Vegetables produce well on manured plots, and good gardens are common. Apple and peach trees make thrifty growth, and apparently produce as regularly as in the higher situations in the Knobs. Orcharding might well be made a considerable industry, for the blue-grass country affords a good and convenient market. Some sorgo is grown, and the sirup is said to be of a lighter and more desirable color than that from sorgo grown on the more productive lands of limestone origin.

Addition of acid phosphate undoubtedly would prove beneficial to crops. The content of organic matter could be increased profitably by growing clover and cowpeas. Lime likely would help to get better crops of clover.

ELK SILT LOAM.

The Elk silt loam is a rich-brown, mellow silt loam, grading at about 10 to 15 inches into yellowish-brown to brownish-yellow friable silty clay loam to silty clay.

The type is most extensive on the terraces along the Dix River, occurring at various levels ranging from a rather low position in the area farthest upstream in the county to high situations on the summits of elevations, well above the general upland level, in the northern end of the county. All the Dix River terraces except the one farthest up stream are high and bounded by cliffs.

There is a scattering to rather large content of small rounded gravel of chert and quartz, and of small to rather large geodes. This material is not bedded. It is more abundant in the higher terraces farther north than in the south. It is said that the coarser material does not interfere seriously with cultivation. Generally the larger geodes have been removed. They are similiar to those of the Waverly formation in the Knobs, and presumably the soil is in part of material from that district.

The topography is variable. Generally the surface is rather unevenly sloping or very gently rolling. The more even surfaces are in many places pitted with sinks. The terrace deposits are not deep, and at the greater breaks in the slope and around these sinks there is more or less soil that is partly or altogether residual and mainly the Lowell silt loam. There is a considerable proportion of residual soil in the modified terrace areas at Davistown and the one 3 miles northwest of Buena Vista.

The typical Elk silt loam is productive. Corn yields 40 to 60 bushels per acre on sod, clover 1 to 2 tons, timothy 1 to 2 tons, and wheat 10 to 15 bushels. The highest terrace deposits apparently do not hold bluegrass as well as the adjoining residual soils and are considered less productive.

The terraces on Paint Lick Creek are not high above the first bottom. The surface is smooth, and the soil is typical and free of gravel.

The terraces of Kentucky River near and above Lock No. 8, included in the type as mapped, are really Elk fine sandy loam. The surface soil is a brown to yellowish-brown fine sandy loam, 6 to 12 inches deep, overlying friable brownish-yellow to yellowish-brown silty clay loam to silty clay. These terraces occupy moderately high situations sloping to the first bottoms. They are free of gravel, though occasional fragments of the Garrard sandstone appear. Drainage conditions are good. The soil is easily tilled and productive. Corn, clover, timothy, wheat, and tobacco are produced. After clover the yields are about equal to those of the uplands. It is said that apples do well on the type, and melons and vegetables produce especially well,

POPE SILT LOAM.

The surface soil of the Pope silt loam is a light-brown silt loam grading at about 6 to 8 inches into yellowish-brown or yellow silt loam. This is underlain at about 15 to 20 inches by mottled yellow and gray heavy silt loam. The subsoil is more mottled than the typical Pope silt loam of other parts of the country.

The type occupies the stream bottoms in the Knobs. These bottoms usually lie rather high and are seldom overflowed. Some are so high as to be more accurately described as second bottoms. The soil and moisture conditions are quite uniform through the main extent

of the type. In the upper valleys of these streams and at the mouths of small branches there is more or less unassorted outwash material containing a good deal of shale.

Corn and redtop are the principal crops. Corn yields up to 30 bushels per acre, and redtop up to a ton per acre. Redtop, combined with a natural growth of lespedeza, also affords fair to good pasture. The type is farmed about the same as the Tilsit silt loam. It evidently has better moisture conditions and is more productive. Acid phosphate could probably be used to good advantage.

HUNTINGTON SILT LOAM.

The Huntington silt loam, as most typically and extensively developed along the larger local streams in the limestone formations, is a deep-brown, mellow silt loam, showing little change to a depth of 3 feet, or passing into somewhat lighter brown heavy silt loam to silty clay loam. In places the lower subsoil is faintly mottled with gray and contains some dark concretions.

In the Kentucky River bottom near the confluence with Paint Lick Creek the soil consists of brown, mellow silt loam grading into yellowish-brown, slightly more compact, yet friable, silt loam, which in places is somewhat sandy. There are some included strips of fine sandy loam near the banks of the streams.

The streams flow on bedrock, and bedrock underlies the bottoms, usually at 4 to 7 feet. The bottoms are subject only to rather infrequent overflows. They are commonly used as sites for dwellings. In places they are protected from cutting by stone walls built on the bedrock of the channel, but leaving a wide channel. A few second bottoms are included with the type as mapped.

Many of these bottoms are planted to corn for years in succession and yield 40 to 80 bushels per acre. But after a time yields are said to decrease somewhat, when they are frequently seeded to clover. Clover thrives, yielding 1 to 2 tons per acre. Tobacco also produces heavily, yielding up to 1,600 pounds per acre, and yields of 2,000 pounds of good quality have been obtained. The quality is best in drier seasons; in wet seasons the growth is too rank and the quality inferior, so that where productive upland soils are available tobacco is more commonly planted on the upland.

The narrow bottoms along the smaller streams in the limestone country are not so well drained. The bedrock in many places occurs at shallow depths. Where bedrock is reached at a depth of 3 feet, the lower subsoil is frequently mottled. Numerous narrow bottoms that occur in patches, having been hollowed out to a flat surface in softer rock, are rather poorly drained, and have a mottled grayish and yellowish, plastic subsoil, representing the Holly silt loam. Many of these have been covered over to some depth with recent wash from cultivated fields, and are scarcely typical of the Holly. Bluegrass thrives on most of these narrow bottoms and would thrive on all if ditched. Both the typical Huntington silt loam and these poorly drained soils, being in narrow strips inconvenient for cultivation, but having good water and shade, are commonly used for pasture, along with adjacent stony slopes and bluffs.

Near the Knobs, where some of the soil material is from the Dekalb soils, the creek bottoms are also somewhat "cold," and some mottling in the subsoil indicates imperfect underdrainage.

The bottoms in the sandstone country are generally typical in color and texture, but are to some extent of unassorted material washed from the adjoining slopes and in places contain scattered slightly worn fragments of limestone and sandstone. These bottoms are narrow and the stream channels are wide. Commonly the bottoms are protected by stone walls against the freshets which follow heavy rain. The streams flow on bedrock, littered with slabs and cobbles of limestone. In the vicinity of Judson, on Sugar Creek, the streams have not been successfully confined, and in places nearly the whole width of the bottoms is of stony wash with little earth included. These places are indicated on the map by gravel symbols.

The bottoms of Kentucky River are variable. They include a good deal of Huntington silt loam, and were mapped as such, the differences being on such a small scale and involving so many variations of structure and position that they could not well be indicated. The river bottoms are for the most part only narrow strips a hundred yards or less in width, with some wider places near the mouths of streams. Most of them lie rather high and are seldom overflowed, even though the river has been locked. In many places they slope somewhat to the river.

The higher parts of the bottoms are mainly Huntington silt loam, but below the mouths of the local streams even the higher bottoms are mostly of Huntington fine sandy loam. The surface soil is a brown fine sandy loam. This is underlain at about 8 to 12 inches by brown or yellowish-brown silty clay loam to silty clay. These high sandy bottoms occur for some distance below the mouths of Paint Lick Creek and Canoe Creek; and throughout the extent of the bottoms there is a strip of deep, mellow, fine sandy loam next the stream, occupying the river bank, occasional strips of "low bottom" a rod or two in width and extending in places over part of the higher bottom. The heads of bottoms are generally deeply covered with this sandy material for some distance. Next the cliffs there is frequently included a narrow strip of somewhat elevated or sloping bottom which contains heavy silty clay washed from the cliffs, and next this there may be a narrow swale of Holly silt loam or silty clay loam. These bottoms are remarkably free of rock fragments, there being usually none even next the cliff.

This type is derived entirely or mainly from limestone soils. It is much more productive than the Pope silt loam, derived from the noncalcareous shales of the Knobs section. In addition to being well suited for the production of corn, clover, and hempseed, it is an excellent garden soil. Rotation of crops is necessary to maintain yields on the higher bottoms.

ROUGH STONY LAND.

The steep sides of the river gorges, together with extensions along some of the affluent streams and also some conspicuous ledges of the Knobs section, have been classed as Rough stony land. Although in places on the outside of curves the river cliffs are sheer, there is

generally a narrow strip of steeply sloping soil at the base of the cliff and some steep stony land at the edge of the plateau. On the inside of curves there is usually a considerable height of cliff, but above and below it are steep slopes with sufficient earth to support a forest growth. In some places hogs are ranged in these woods. This land is not arable.

CHEMICAL ANALYSES.[3]

INTRODUCTION.

In order that this chapter may meet the needs of the agricultural public, brief explanations and references are necessary. These, taken in connection with the tabulated analyses representing the different types of soil in the county, enable the reader to get more readily the true significance of the analyses.

Garrard County possesses a diversified geology, in consequence of which there are important differences in its soils, rendering necessary different practices in the maintenance of fertility.

The incorporation of fertilizers, limestone, and organic matter with the soil is limited by the depth of plowing, which is ordinarily about 7 inches, and the feeding roots of most plants function mainly within this depth; therefore we consider the analysis of the top soil more significant, as a rule, than that of the subsoil, in connection with crop production.

The analyses reported herein are stated as parts per million of the dry sifted soil, exclusive of whatever material has been removed by the 2 millimeters sieve (about one-twelfth inch) in the preparation of the samples for analysis. If the amount removed is large, it should be considered in computing the quantities in the original soil or the pounds per acre of the substances determined.

Average amounts of nitrogen, phosphorus, and potassium contained in various crops.

Crop.	Nitrogen.	Phosphorus.	Potassium.
	Pounds.	*Pounds.*	*Pounds.*
Corn, 50 bushels per acre, contains	50	9	10
Stalks, 1½ tons	25	3	26
Total	75	12	36
Wheat, 25 bushels per acre, contains	36	6	6
Straw, 1¼ tons	12	2	23
Total	48	8	29
Oats, 40 bushels per acre, contains	26	5	6.5
Straw, 1 ton	13	3	21
Total	39	8	27.5
Tobacco, 1,000 pounds of leaf, contains	40	2.2	50
Stalks, 300 pounds	10	.8	10
Total	50	3	60
Red clover hay, 1 ton per acre, contains	40	5	30

When it is desired to convert parts per million to pounds per acre, we assume that the weight of dry soil on an acre to the depth of 7 inches is 2,000,000 pounds and that the subsoil from 7 to 20 inches

[3] This chapter prepared by S. D. Averitt, of the Kentucky Agricultural Experiment Station.

over the same area weighs 4,000,000 pounds. These assumed values, though not exact, are near enough to the true weight of the soil to involve no practical error. Then, to convert parts per million to pounds per acre, multiply by 2 for the first 7 inches or surface soil, and by 4 for the next 13 inches or subsoil.

The table on page 544 shows the plant food contained in the main crops grown in the State, calculated for yields which may be considered attainable at a profit. A more extensive table of such values and a detailed discussion of them with reference to soil analyses and maintenance of fertility will be found in Part II of Bulletin No. 228 of the Kentucky Agricultural Experiment Station.

METHODS OF SAMPLING AND ANALYSIS.

The sampling was done uniformly as follows: On a representative area of the type or phase, selected after mapping, composite samples of surface soil, 0 to 6 inches, and of subsoil, 6 to 18 inches, were taken by means of a soil auger such as is used by the Bureau of Soils. The samples of surface soil usually consisted of the earth from 12 borings. The subsoil was taken from about half of the holes made for the surface soil. After these samples had been air-dried, they were rubbed up in a Wedgewood mortar, being careful not to crush the gravel, and sifted with a sieve having circular openings 2 millimeters in diameter. If gravel or stones were obtained, the amount was determined as percentage of the air-dry sample. When the gravel removed amounted to as much as one-half of 1 per cent, the percentage is given under the type tabulations. The earth which passed the sieve, after thorough mixing, constituted the sample for analysis. A part was ground finer for determination of total potassium, phosphorus, and nitrogen, but the portion used for digestion in one-tenth normal nitric acid was not ground. Portions were weighed out equivalent to the desired amount of moisture-free soil, so the findings are expressed on the moisture-free basis.

The methods of analysis used are as follows: Total nitrogen (N), Kjeldahl method, 5 hours' digestion. Total phosphorus (P), magnesium-nitrate method. (Methods of analysis, A. O. A. C., 1920, pp. 314 and 318). Total potassium (K), the modified J. L. Smith method, as adopted by the A. O. A. C. in 1909. (See Bureau of Chemistry Bulletin No. 132, and Bulletin No. 122, p. 116.) N/10 HNO_3 digestion for easily soluble potassium, phosphorus, and calcium. A weight equivalent to 75 grams of water-free soil was digested in 1,500 cubic centimeters of N/10 HNO_3 for one-half hour at room temperature and filtered though a dry paper filter. The residue from 1,000 cubic centimeters of the clear filtrate was evaporated twice with HCl to get rid of HNO_3, taken up with HCl and water and the silica filtered out and washed and the filtrate made to 100 cubic centimeters. Aliquots of 10, 50, and 32.2 cubic centimeters were taken for Ca, P, and K, respectively. CaO to neutralize. The method is essentially that given in Journal of the A. O. A. C., volume 1, No. 4, page 25. One cubic centimeter St. KOH = 0.004 gram $CaCO_3$, or 0.01 per cent, instead of 0.001 per cent, as stated in the text.

In the tabulations the subsoil is designated by the next following number to that representing the surface soil; thus, sample No. 80001 is a sample of the first 6 inches of Shelbyville silt loam, and No. 80002 is its corresponding subsoil, 6 to 18 inches.

Chemical analyses.

[Parts per million of the moisture-free fine earth.]

Soil type and sample number.	Total nitrogen (N).	Total phosphorus (P).	Phosphorus (P) dissolved by N/10 HNO_3.	Total potassium (K).	Potassium (K) dissolved by N/10 HNO_3.	Calcium (Ca) dissolved by N/10 HNO_3.	Acidity as lime (CaO) to neutralize.
Shelbyville silt loam:							
0 to 6 inches—							
[1] 80001	1,740	1,105	38	13,800	315	2,500	10
[1] 80013	1,540	2,510	163	13,400	154	3,320	10
[1] 80016	1,640	1,020	19	15,600	102	1,540	20
[1] 80036	1,300	1,180	18	14,700	142	1,140	35
Average	1,555	1,454	59	14,375	178	2,125	19
Maximum	1,740	2,510	163	15,600	315	3,320	35
Minimum	1,300	1,020	18	13,400	102	1,140	10
6 to 18 inches—							
[1] 80002	700	1,160	18	12,200	232	1,460	10
[1] 80017	1,200	705	17	14,700	82	1,680	10
[1] 80037	1,140	1,040	16	14,800	179	1,160	30
Average	1,013	968	17	13,900	164	1,433	17
Maury silt loam:							
0 to 6 inches—							
[1] 80003	1,000	16,640	6,780	14,700	164	14,960	10
[1] 80011	1,480	11,320	4,272	14,100	190	14,000	Neutral.
Average	1,240	13,980	5,526	14,400	177	14,480	
6 to 18 inches—							
[1] 80004	540	29,200	7,787	15,800	66	18,200	10
[1] 80012	960	14,480	5,248	14,500	189	14,100	Neutral.
Average	750	21,840	6,517	15,150	127	16,150	
Maury silt loam, rolling phase:							
0 to 6 inches—							
[1] 80005	900	1,725	138	14,300	162	1,380	10
[1] 80024	1,740	950	15	14,800	195	1,460	10
Average	1,320	1,337	76	14,550	178	1,420	10
6 to 18 inches—							
[1] 80006	540	1,610	58	15,200	136	1,060	50
[1] 80025	1,080	580	11	14,200	153	1,200	15
Average	810	1,095	34	14,700	144	1,130	32
Lowell silt loam:							
0 to 6 inches—							
[1] 80007	1,600	1,720	66	16,600	248	2,180	10
[1] 80014	1,460	2,120	165	20,700	243	1,480	50
[1] 80032	1,240	3,730	1,076	23,300	158	4,560	210
Average	1,433	2,523	434	20,200	216	2,740	90
6 to 18 inches—							
[1] 80008	880	1,400	23	17,800	148	2,040	Neutral.
[1] 80015	760	3,290	890	25,700	112	3,920	1,040
[1] 80033	680	5,310	1,030	25,800	122	9,100	480
Average	773	3,333	648	23,100	127	5,020	507
Lowell silty clay loam:							
0 to 6 inches—							
[1] 80030	960	1,255	47	28,200	136	1,900	70
[1] 80042	2,760	1,610	352	30,300	241	700	5
Average	1,860	1,433	199	29,250	189	1,300	38
6 to 18 inches—							
[1] 80031	620	1,530	120	31,900	112	2,020	400

[1] Gravel removed by the 2-millimeter sieve, as per cent of the air-dry sample: No. 80001, 0.6; No. 80002, 1.4; No. 80013, 0.1; No. 80026, 0.3; No. 80017, 0.6; No. 80036, 1.1; No. 80037, 0.1; No. 80003, 0.2; No. 80004, 0.7; No. 80011, 0.1; No. 80012, 0.1; No. 80005, 0.1; No. 80006, 1.3; No. 80024, 0.1; No. 80025, 0.1; No. 80007, 4; No. 80008, 9; No. 80014, 1; No. 80015, 0.1; No. 80032, 0.3; No. 80033, 4.3; No. 80030, 4.2; No. 80031, 7.8; No. 80042, 0.1; No. 80020, 7.1; No. 80021, 4.9; No. 80023, 3.2; No. 80034, 2.5; No 80038, 7.1; No. 80039, 0.3; No. 80043, 0.6; No. 80044, 0.3; No. 80045, 0.2; No. 80018, 4; No. 80019, 5.7; No. 80028, 6.8; No. 80029, 8.1; No. 80026, 3.6; No. 80027, 0.1; No. 80009, 2.3; No. 80010, 4; No. 80040, 1.4; No. 80041, 1.2.

Chemical analyses—Continued.

Soil type and sample number.	Total nitrogen (N).	Total phosphorous (P).	Phosphorous (P) dissolved by N/10 HNO_3.	Total potassium (K).	Potassium (K) dissolved by N/10 HNO_3	Calcium (Ca) dissolved by N/10 HNO_3.	Acidity as lime (CaO) to neutralize.
Fairmount silty clay loam:							
0 to 6 inches—							
[1] 80020	1,800	1,190	.....	12,300	.....	.....	[2] 758,000
80022	1,900	1,380	.....	28,300	.....	.....	[2] 153,000
Average	1,850	1,285	.....	20,300	.....	.....	455,500
6 to 18 inches—							
[1] 80021	700	1,230	.....	15,700	.....	.....	577,500
[1] 80023	660	1,440	.....	21,600	.....	.....	496,400
Average	680	1,335	.....	18,650	.....	.....	536,950
Culleoka gravelly silt loam:							
0 to 6 inches—							
[1] 80034	840	1,850	288	31,300	131	2,660	50
[1] 80038	1,500	1,470	30	20,300	107	1,600	20
[1] 80043	1,440	1,250	62	27,200	204	860	50
[1] 80045	1,180	1,160	24	15,200	97	740	140
Average	1,240	1,432	101	23,500	135	1,465	65
6 to 18 inches—							
80035	680	1.630	68	28,700	104	2,280	15
[1] 80039	960	1,280	28	24,000	98	1,720	10
[1] 80044	360	1,245	20	24,700	98	400	860
Average	667	1,385	39	25,800	100	1,467	295
Lebanon silt loam:							
0 to 6 inches—							
[1] 80018	960	630	21	7,400	84	700	90
6 to 18 inches—							
[1] 80019	370	585	10	8,400	68	560	1,010
Dekalb silt loam:							
0 to 6 inches—							
[1] 80028	1,000	380	12	16,100	120	700	320
6 to 18 inches—							
80029	480	390	10	17,000	91	280	1,530
Tilsit silt loam:							
0 to 6 inches—							
[1] 80026	880	425	22	11,500	95	640	480
6 to 18 inches—							
[1] 80027	400	285	17	13,800	63	300	1,960
Elk silt loam:							
0 to 6 inches—							
[1] 80009	760	1,170	35	11,300	104	920	20
[1] 80040	960	890	16	10,300	83	600	170
Average	860	1,030	25	10,800	93	760	95
6 to 18 inches—							
[1] 80010	420	1,090	41	11,700	100	1,200	90
[1] 80041	660	750	14	9,200	73	7,480	65
Average	540	920	27	10,450	86	4,340	77

[1] Gravel removed by the 2-millimeter sieve, as per cent of the air-dry sample: No. 80001, 0.6; No. 80002, 1.4; No. 80013, 0.1; No. 80016, 0.3; No. 80017, 0.6; No. 80036, 1.1; No. 80037, 0.1; No. 80003, 0.2; No. 80004, 0.7; No. 80011, 0.1; No. 80012, 0.1; No. 80005, 0.1; No. 80006, 1.3; No. 80024, 0.1; No. 80025, 0.1; No. 80007, 4; No. 80008, 9; No. 80014, 1; No. 80015, 0.1; No. 80032, 0.3; No. 80033, 4.3; No. 80030, 4.2; No. 80031, 7.8; No. 80042, 0.1; No. 80020, 7.1; No. 80021, 4.9; No. 80023, 3.2; No. 80034, 2.5; No. 85038, 7.1; No. 80039, 0.3; No. 80043, 0.6; No. 80044, 0.3; No. 80045, 0.2; No. 80018, 4; No. 80019, 5.7; No. 80028, 6.8; No. 80029, 8.1; No. 80026, 3.6; No. 80027, 0.1 ; No. 80009, 2.3; No. 80010, 4; No. 80040, 1.4; No. 80041, 1.2.

[2] Calcium carbonate.

Locations from which samples were taken.

Laboratory numbers.	
80001– 2.	3 miles northwest of Lancaster.
80003– 4.	¾ mile east of Buena Vista.
80005– 6.	2½ miles a little east of north of Buena Vista.
80007– 8.	Near same location as preceding.
80009–10.	2 miles west of Buena Vista.
80011–12.	½ mile west of Camp Dick Robinson.
80013	½ mile west of Burdette Knob.
80014–15.	½ mile south of Point Leavell.
80016–17.	1½ miles northwest of Hammack.
80018–19.	½ mile northwest of Hammack.
80020–21.	2 miles southwest of Hammack on Bald Hills.
80022–23.	2 miles northeast of Cartersville.
80024–25.	1½ miles northeast of Cartersville.
80026–27.	1 mile south of Cartersville.
80028–29.	1 mile south of Cartersville.
80030–31.	1 mile southwest of Point Leavell.
80032–33.	½ mile southeast of Point Leavell.
80034–35.	1 mile south of Buckeye.
80036–37.	200 yards north of forks of Danville pike and main road to Hubble.
80038–39.	3 miles west of Lancaster, on Danville pike.
80040–41.	Danville pike, on Dix River.
80042	1 mile east of Dix River, Danville pike.
80043–44.	1 mile south of Bourne.
80045	Top of ridge above location of preceding sample.

From the foregoing table it will be seen that the Shelbyville silt loam contains a fair amount of easily soluble potassium and phosphorus, an average of 356 pounds per acre of the former and 118 pounds of the latter in the surface soil. Total nitrogen, potassium, and phosphorus in both surface and subsoil are moderately high. The maintenance of fertility on this type should be fairly easy.

The Maury silt loam is characterized by the very high total and easily soluble phosphorus. This is a Trenton soil found in the western part of the county. Its fertility is easily maintained. The rolling phase of this type presents a more difficult problem, as the phosphorus content is much lower and its topography less favorable.

One sample of surface soil and the corresponding subsoil (Nos. 80032 and 80033) in the Lowell silt loam are remarkable for the relatively high total and easily soluble phosphorus and high easily soluble calcium. This sample approaches in these respects a Trenton soil. It is, however, well up in the Cincinnatian and results from the weathering of a limestone known as the Arnheim, which carries a considerable quantity of tricalcium phosphate ($Ca_3(PO_4)_2$).

In the Lowell silty clay loam tabulation sample No. 80042 is rather remarkable for the relatively large content of easily soluble phosphorus and low content of calcium, a condition which does not usually obtain. The total nitrogen, total potassium, and easily soluble phosphorus are quite large. These types present about the same agricultural conditions as the Shelbyville silt loam.

The samples of the Fairmount silty clay loam contain so much calcium carbonate that it is not practicable to determine the easily soluble calcium, phosphorus, and potassium in N/10 HNO_3. The type is fully described in a preceding section of this report and needs no further comment. Samples 80020, 80021, and 80023 are rich enough in calcium carbonate to be used as agricultural marls. In fact, they are more properly marls than soils.

The Culleoka gravelly silt loam, already stated, is derived from material resulting from the disintegration of a mudstone known as the Garrard sandstone. This rock usually contains about 2 per cent of tricalcium phosphate and more or less calcium carbonate, weathered samples containing very little. A sample collected in the progress of this survey shows a banded structure; one band was sandy and the other contained some calcium. The sandy material contained 0.424 per cent of phosphorus and the calcareous band contained 0.456 per cent of phosphorus and 24.8 per cent of calcium carbonate. The soil is quite productive.

The remaining types, Lebanon silt loam, Dekalb silt loam, Tilsit silt loam, and Elk silt loam are not extensive. They contain less nitrogen, phosphorus, potassium, and calcium than the other types. The organic matter should be increased by turning under legumes grown with the use of phosphate and ground limestone. In this way they may be brought to a fair degree of productiveness.

For information on the management of the soils of the county, including fertilizer practices, the reader is referred to Bulletin No. 228 and Extension Circulars Nos. 123 and 129, which may be obtained free upon application to the Kentucky Agricultural Experiment Station, Lexington, Ky.

SUMMARY.

Garrard County is situated in east-central Kentucky, adjacent to the Kentucky and Dix Rivers. It has an area of 237 square miles. Most of county is within the bluegrass region. This comprises three distinct topographic divisions. The northwestern part of the county includes considerable areas of undulating and gently rolling country; the north-central part of the county is mainly hilly and deeply dissected country; the south-central part of the county is mainly rolling to hilly country. The southern part of the county is a district of high rugged land called the Knobs.

The rivers occupy deep valleys and gorges. Their branches have cut quite deeply, with little development of bottom lands or graded lower slopes. The levels, ridges, and hills of the bluegrass sections lie at elevations approximating 1,000 feet above sea level; the Knobs reach elevations of 1,400 feet.

The population of the the county numbers 12,503. It is mainly of English descent. The negro population is about 15 per cent of the total.

The county is well settled. The average size of farms in 1920 was 86.5 acres. Lancaster is the only town of any size in the county, and the interests of the county are almost entirely agricultural.

The climate is temperate. The mean annual precipitation is about 48 inches and is well distributed through the season. Altogether the climatic conditions are favorable for crop production and stock raising.

General farming was formerly the dominant type of agriculture, but tobacco is now produced on a large acreage and is the main source of income on many farms. In 1919 corn was grown on 27,340 acres, tobacco on 11,996 acres, wheat on 9,691 acres. The production of

hogs and cattle is of importance, and some dairy products are produced on many farms. Corn and tobacco are produced in rotation with red clover, and pastures of timothy and bluegrass occupy about half the acreage of farm lands.

Fertilizers are not commonly used. The farms are small, and the hiring of labor is not extensive. Two-thirds of the farms are operated by the owners.

The rock formations of the bluegrass sections are of limestone and calcareous shale, with an important and extensive local development of the Garrard sandstone. The Knobs formations are mainly of noncalcareous fissile shales.

The limestone soils of the county are mainly of the Shelbyville, Maury, Lowell, and Fairmount soil series. The smooth and gently rolling uplands are occupied chiefly by the Shelbyville and Maury silt loam soils. They are well drained and highly productive of corn, clover, timothy, tobacco, and bluegrass. The Lowell silt loam is similar in productiveness. The surface is rolling to hilly. The Lowell silty clay loam mainly represents washed areas of the silt loam.

The Fairmount stony silty clay loam is quite hilly and is best farmed for a short time at intervals of years. It is good bluegrass pasture land.

The Fairmount silty clay loam and its eroded phase differ in origin from the other soils of the series. They are subject to washing and not well adapted to cultivation.

The Culleoka gravelly silt loam, derived from the Garrard sandstone, is very hilly, but is a valuable tobacco soil, and is highly productive of corn and clover.

The poorly drained land of the flatwoods is classified as the Lebanon silt loam. It is not very productive.

The principal soil of the Knobs is the Dekalb silt loam. In this county the type is essentially a forest soil. The soil of graded lower slopes in the Knobs, classified as the Tilsit silt loam, is moderately productive of redtop and corn. The soil of the first bottoms along streams in the Knobs, classified as the Pope silt loam, is somewhat more productive than the Tilsit silt loam.

The soil of the first bottoms of streams in the bluegrass section, mapped as the Huntington silt loam, is highly productive of corn, clover, tobacco, and bluegrass. The terrace soil within the bluegrass country, classified as the Elk silt loam, is similar in productiveness to the upland soils.

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U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF SOILS
IN COOPERATION WITH THE
KENTUCKY AGRICULTURAL EXPERIMENT STATION

SOIL MAP

KENTUCKY
GARRARD COUNTY SHEET

LEGEND

- Culleoka gravelly silt loam — Cg
- Lowell silt loam — Ls
- Dekalb silt loam — Dl
- Lowell silty clay loam — Lc
- Elk silt loam — El
- Maury silt loam — Ms
- Fairmount stony silty clay loam — Fs
- Ms — Rolling phase
- Fairmount silty clay loam — Fc
- Pope silt loam — P
- Fc — Eroded phase
- Shelbyville silt loam — Ss
- Huntington silt loam — Hl
- Tilsit silt loam — Ts
- Lebanon silt loam — Ll
- Rough stony land — R
- Ll — Gravelly phase

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

- City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
- Secondary roads and Trails
- Railroads Steam and Electric
- Bridges, Ferry
- R.R. crossings, Tunnel
- Ford, Dam
- School or Church Cemeteries
- Mine or Quarry Mine dumps Made land
- Bluff, Escarpment, Rock outcrop and Triangulation station
- Stony and Gravelly areas
- Soil boundaries
- Boundary lines
- Boundary lines
- Boundary lines
- U.S. township and section lines

RELIEF
(Printed in brown or black)

- Contours Depression contours
- Prominent Hills Mountain Peaks
- Sand, Wash, and Sand dunes
- Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

- Streams
- Lakes, Ponds, Intermittent lakes
- Intermittent streams
- Springs, Canals and Ditches, Flumes
- Swamp Salt marshes
- Submerged marsh Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Soils surveyed by J. A. Kerr of the U. S. Department of Agriculture, in charge, and S. D. Averitt of the Kentucky Agricultural Experiment Station

BASE MAP IN PART FROM
U. S. GEOLOGICAL SURVEY SHEETS

1 ½ 0 1 2 3 4 Miles

Scale 1 inch=1 mile

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

Field Operations
Bureau of Soils
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